THE ANNUAL REPORT

of the

Northeastern Forest Experiment Station

1950

Northeastern
Forest Experiment Station
Upper Darby, Pa.
V.L. Harper, Director

NORTHEASTERN FOREST RESEARCH ADVISORY COUNCIL

Chairman : *PAUL KOENIG, Vice President, P.H. Glatfelter Company, Spring Grove, Pa.*

Vice chairman : *C. R. ORTON, College of Agriculture and Experiment Station, West Virginia University, Morgantown, W. Va.*

Secretary : *V. L. HARPER, Director, Northeastern Forest Experiment Station, Upper Darby, Pa.*

ALLEN, JAMES H. Executive Secretary, INCODEL, Broad Street Station Bldg., Philadelphia 3, Pa.

BEEDE, VICTOR A. Head, Dept. Forestry, Pennsylvania State College, State College, Pa.

BUCKINGHAM, H. C. State Forester, State Office Bldg., Annapolis, Md.

COOK, H. O. Chief Forester, Div. of Forestry, Dept. of Conservation, 15 Ashburton Place, Boston, Mass.

COPE, FRANCIS R., JR. Woodbourne Orchards, Dimock, Pa.

DEMERITT, D. B. Dead River Company, 6 State Street, Bangor, Maine

FARWELL, THOMAS. President, Ryegate Paper Company, East Ryegate, Vt.

FOSTER, JOHN H. State Forester Forestry and Recreation Commission Concord, N. H.

FREEDMAN, LOUIS J. Penobscot Chemical Fibre Company, Great Works, Maine

GARRATT, GEORGE A. Dean, School of Forestry, Yale University, New Haven 11, Conn.

GIPPLE, O. B. Director, Bureau of Forests, Dept. of Forests & Waters, Harrisburg, Pa.

HOPKINS, A. S. Director, Div. of Lands and Forests, Conservation Dept., Albany, N. Y.

HUTCHINS, CURTIS M. President, Bangor & Aroostock Railroad, Bangor, Maine

JACOBSON, E. G. Chief Forester, Office of Forests & Parks, Dept. of Agriculture & Conservation, 18 State House, Providence, R. I.

KAYLOR, JOSEPH F. Director, Dept. of State Forests & Parks, State Office Bldg., Annapolis, Md.

KIENHOLZ, RAYMOND Forestry Dept., University of Connecticut, Storrs, Conn.

LININGER, F. F. Director, Agr. Expt. Station, Pennsylvania State College, State College, Pa.

MERRILL, P.H. State Forester, Vermont Forest Service, Montpelier, Vt.

NUTTING, A. D. Forest Commissioner, Maine Forest Service, Augusta, Maine

RATHBUN, LAWRANCE W. Forester, Society for Protection of New Hampshire Forests, 3 North State Street, Concord, N. H.

RECKNAGEL, A. B. Technical Director of Forestry, St. Regis Paper Company, 215 State Tower Bldg., Syracuse, N. Y.

REYNOLDS, HARRIS A. Secretary, Massachusetts Forest & Park Association, 3 Joy Street, Boston 8, Mass.

SCHREEDER, W. F. State Forester, 165 Capitol Avenue, Hartford, Conn.

SCHRAMM, J. R. Head, Department of Botany, University of Pennsylvania, Philadelphia, Pa.

SHIRLEY, HARDY L. Assistant Dean, New York State College of Forestry, Syracuse, N. Y.

TABER, W. S. State Forester, State Forestry Department, Dover, Del.

WILBER, C. P. State Forester, Dept. of Conservation & Economic Development, State House Annex, Trenton 7, N. J.

1950

CONTENTS

	Page
Some over-all matters	1
Cutting and logging practices and other aspects of forest management	15
Forest genetics a special project in forest management	46
Watershed management (forest influences)	55
The flood control surveys	66
The forest survey	69
The forest resource and related economic studies	73
The forest utilization service	77
Publications	85
The research centers and experimental forests and watersheds	101

THE ANNUAL REPORT
OF THE
NORTHEASTERN FOREST EXPERIMENT STATION
1950

January 1, 1951

SOME OVER-ALL MATTERS

CHANGES IN THE INTERNATIONAL situation and in the national and regional scene during 1950 have had their influence on the Station's program of forest research. There have been new tasks to undertake and shifts to make in emphasis among various Station projects. But underneath it all the Station has been able during 1950 to make steady progress on the various projects that must characterize any carefully organized effort in forest research.

Some flexibility in plans to meet new and unanticipated needs is desirable and essential. It is hoped, however, that 1951 will not bring with it demands greatly in excess of those that can be handled within the framework of manageable adjustments rather than by abandoning unfinished projects. For those who witnessed the wholesale dropping of forest research, the boarding up of experimental forests, and the closing of forest research offices during World War II, the years immediately ahead hold some concern.

Is the present emergency likely to cause a repetition of events of World War II? Or is this emergency one likely to extend into many years--years of anxiety, of defense mobilization, of possible war, of long and continued heavy drain

on our natural resources? Many thoughtful people see for some time ahead increased demands on the productivity of our land. Can we afford then to abandon or slow down conservation of activities in behalf of our Nation's soil and forest? Do we not need, more than ever, a sustained and evenly accelerated research effort to help find new and better ways of keeping ourselves strong in basic resources?

Our economy is now geared to a level that demands continued full-scale production. As mobilization efforts intensify, as the population increases, the demands will increase. This calls for industrial expansion, including expansion of wood-product manufacturing plants. There must be increasing production for constantly rising requirements for goods and services.

This all translates into a large and continuing demand on our Nation's forest resources. It calls for increasing attention to forest policies and forest practices, involving action programs all the way from legislation to silviculture. It involves research programs for getting the facts on the forest resource situation and for devising remedial measures and improved or more efficient forest management and utilization. Have we the courage during these difficult times of heavy public expenditures for defense mobilization to urge that we stick to planned forest research programs and of even to increase where needed the forest research effort?

The answer involves more than just a matter of saving the initial investment already spent on projects not yet finished. It involves a question of probable duration of the emergency, the added strain on the forest resource, and the premium one puts on research and the role it can play in bringing about new developments and improvements. No modern nation can build up and maintain its strength if it does not maintain a large body of research effort and keep a steady flow of improved practices and processes coming along.

SOME SHIFTS IN PROGRAM HAVE BEEN MADE

As already indicated, the year 1950 with its increasing international tension and its renewed emphasis on defense brought some shifting in the Station's program. Work at our experimental forests is showing how improved cutting and other silvicultural practices can be applied in a manner to meet production demands and still leave a desirable growing stock for

watershed protection and for future production of quality timber. To be sure, costs of logging and other practices may go up somewhat with increased standards of forest practices. This is particularly true when traditional methods of logging and equipment are continued. But to offset any increased cost due to better forestry practices, other studies are showing how improvements in mechanization and in crew organization can cut down on labor requirements. On one experimental forest, for example, the productiveness of a logging crew was increased about 25 percent; on another a crew of four men now does the work that formerly required five men. These and similar results have already come to light from shifts in emphasis of the Station's forest research program.

SOME NEW DEFENSE JOBS HAVE BEEN UNDERTAKEN

Prospective shortages of logging equipment and machinery with the consequent need for a system of priorities and allocations creates a need for more adequate knowledge of the equipment and manpower requirements for each major branch of the logging and wood-processing industry. At the request of the National Security Resources Board and the National Production Authority, the Forest Service began the development of a plan for nationwide survey to procure such information through its regional forest experiment stations.

The Northeastern Station will have a leading role in this job. One of our staff members is scheduled to spend a good deal of his time in Washington and throughout the country on equipment and manpower surveys. Personnel from our Forest Utilization Service, Forest Survey, and other Station activities will cover most of the forest industries in the Northeast in the course of such surveys.

Further assignments related to defense include a study of plant capacity, current production, and raw material supplies in connection with contemplated expansion of Northeastern pulp mills to meet increasing needs for pulp and paper production.

ANOTHER ACTIVITY--RIVER BASIN PLANNING

Another new activity which the Station is now getting into is best described as river basin planning. Since this is a subject not well understood in the Northeast--in fact

regarded with some suspicion--there is good reason for discussing this matter in some detail.

Conflicts Of Interest In Water Use

River basin planning is not "just another new-fangled idea" that has recently sprung from the heads of Federal officials. It is securely rooted in the fact that water (indispensible for the support of all forms of life on our planet) moves in a continuous cycle. Moisture (raised from the surface of the land and from the seas by evaporation) travels with the currents of the atmosphere. Here and there it condenses and falls upon the land as rain or snow. From the place on which it falls, it either evaporates again or it begins to move downhill. On its journey back to the sea through streams, lakes and underground passages, it becomes available for use by plants and animals--humans included.

In some places and times there is not enough water to satisfy all demands. In others there is too much, and this often leads to destruction and death. The maintenance and control of a desirable balance of water supply (of required purity) is a tremendously intricate problem.

There are many basic conflicts in water use. Some people want to drink water that others have polluted by discharge of sewage and other wastes. Some want to divert water for domestic and industrial consumption while others want it left in the stream to float river boats. Some people want water stored in reservoirs only when necessary to prevent floods. Other people want the flood waters to be stored and released at a constant rate for the production of hydroelectric power. Some people want no dams at all in major streams because they interfere with the migration of fish. It is unnecessary to labor this point any further. We are all aware of these conflicting interests.

Water-Land Relationships

But there is another class of conflicts that is not confined to the users of water. Timberland owners want to harvest their trees--often times in a way that will bring them the maximum immediate financial return. The stripping of timber from a watershed (especially when followed by slash fires) causes accelerated runoff and consequent floods in the valleys below.

Land exposed by tillage, unless carefully managed, is subject to erosion. This causes the siltation of streams and the build-up of sediment deposit in the bottom of river channels, causing water to spill over banks and flood the land. Silt also fills up reservoirs, destroys the aquatic food supply of fish along with their spawning beds, and causes a number of other kinds of damage. Instances in which one form of land or water use has done violence to another are too common to need further elaboration. Such facts are well known. But for some reason, many of our policies and actions fail to take them into account.

These water and water-land problems would be well nigh insoluble were it not for the fact that they can be tackled in reasonably manageable segments. Land and water conditions that cause problems in the Connecticut River basin do not effect the Delaware River basin. The effective strategy is to deal with each major basin (or group of small basins) separately, and to deal with each basin as a whole. There is no justification for trying, as we have too often done, to deal with water conservation problems on a single-purpose or on a State-by-State basis. Such an approach not only intensifies conflicts but often leads to mistakes and waste.

Mileposts In Federal Legislation

The general conclusion just stated has been slowly but steadily emerging in the pattern of Federal legislation over the past century. It is well to recall a few of the mileposts along the legislative road that has brought us to the present point of view on water-resource management. The trend is clearly from single-purpose to multiple-purpose projects and to more and more recognition of the basic unity of the watershed as a whole.

Navigation

The Federal Government assumed responsibility for the maintenance and improvement of navigable waterways in 1824. Authority to lease waterpower from a Federal navigation dam on the Mississippi River to a private company was conferred upon the Department of the Army by an Act of 1879. Various other Federal statutes have regulated the construction and location of bridges, dams, and other structures that interfere with the navigation of inland waterways. Other laws have required that the Department of the Army, in its planning for the improvement of navigation, shall take into account the need for port facilities and the relationship of the navigation services to the general economy of tributary areas.

This authority to expand the scope of waterway investigations was extended and made specific in the Act of 1927. This directed the Department of the Army to proceed with general surveys of all the major river systems of the country and to study, in addition to navigation, the possibilities for hydroelectric power development, for flood control, and for irrigation. Surveys of some 200 rivers have been made under this authority. Results have been submitted to Congress in the so-called "308 Reports".1/ These have served as the basis for initiating important water-resource development programs and as the foundation for broader and more inclusive plans.

Irrigation

The Reclamation Act of 1902 set up a revolving fund and authorized the Federal Government to build irrigation works and deliver water to farms in the Western States. Repayment of the cost of the irrigation works by the water users over a period of years has been required. A 1907 amendment to the Reclamation Act authorized the sale of surplus hydroelectric power from irrigation dams--recognizing that these structures might serve more than one purpose and that revenue so obtained could be used to "write off" a part of the cost of irrigation works.

This general principle came into full recognition when President Collidge signed the Boulder Canyon Project Act of 1927. This frankly recognized hydroelectric power production as one of the major purposes of the Hoover Dam--the others being irrigation, municipal water supply, and flood control. Further development of large projects such as Grand Coulee in the Pacific Northwest and Central Valley in California have brought power revenues into a prominent place in the financial justification of reclamation projects.

Flood Control

Serious floods in the Mississippi River Valley have been a Federal concern for a long time. The earlier Federal action was limited to disaster relief. This was followed in 1879 with legislation establishing the Mississippi River Commission. Little was done, however, until the great flood of 1916 convinced Congress that the Commission should have Federal funds

---

1/ This designation has been used because the directive for their preparation was contained in House Document No. 308, 69th Congress.

sufficient to build a more effective levee system. This was followed by another lag in Federal interest which lasted until the floods of 1927 prompted the initiation of the "308 Surveys."

Floods again in 1936 stimulated further Congressional action on a much wider front. This time the Department of the Army received the go-ahead signal for the preparation of a multi-billion dollar program of flood control works to be financed almost entirely from Federal funds. This program, as developed up to 1948, calls for the expenditure of some $12 billion. Many of the projects are multiple-purpose.

Hydroelectric Power Development

The developing role of the Federal Government in generating hydroelectric power as an incidental product from navigation, irrigation, and flood control dams has already been indicated. Within certain areas of the country (Tenessee Valley, Columbia Valley, lower Colorado River area, and some others) this has passed from an incidental to a major function in the water-resource development program.

This positive policy, first expression in the Boulder Canyon Project Act of 1928, was carried further by the Tennessee Valley Authority Act of 1933, the Bonneville Project Act of 1937, the Rural Electrification Act of 1936, the Fort Peck Act of 1938, and a number of other laws. The intent of Congress, as expressed in the Fort Peck Act (and also in the TVA and Bonneville Acts) is "to encourage the widest possible use of electrical energy that can be generated and marketed and to provide reasonable outlets therefor, and to prevent the monopolization thereof by limited groups."

This, of course, is still a somewhat controversial policy. It is challenged not only by the private electrical utility interests but also by some of the irrigation interests who would like to see power sold at a price "as high as the traffic will bear" in order to provide greater revenues for the subsidizing irrigation projects. Some extremely complicated and troublesome policy issues are involved in this matter. Those who favor the present policy point out that power is one of our basic natural resources which can be used to unlock other resources that would otherwise remain unused. They point to the fact that large supplies of low-cost power developed at Federal multiple-purpose projects have been a powerful stimulus to new industrial development in the Pacific Northwest, in southern California, and in the Tennessee Valley.

Watershed Management

Federal concern and implied responsibility for the improvement or safeguarding of major watersheds found legal expression in the 1897 Act that authorized the setting aside of western public domain lands for national forests. The "securing of favorable conditions for water flows" was one of the stated purposes. A far more vigorous move in this same direction came in 1911 with the passage of a law sponsored by Senator Weeks of Massachusetts. This Act authorized the Federal Government to acquire and manage watershed lands of navigable streams with a view to the stabilization of streamflow and the prevention of floods. The national forests of the eastern States have all been acquired under this legislation.

The Flood Control Act of 1936 recognized for the first time the place of watershed management in the water-control program. It authorized the Department of Agriculture to make watershed surveys and to recommend measures for the retardation of runoff and the prevention of erosion. Further legislation in 1944 authorized the installation of recommended measures on 11 watersheds.

The Soil Conservation Act of 1935 established the Soil Conservation Service. One of its major duties was to advise and aid farmers on how to prevent soil erosion and how to safely dispose of excess runoff. Further legislation in 1936 authorized the Department of Agriculture to make payments to farmers to help defray the cost of soil and water conservation practices carried out on their own farms.

Various laws passed during this general period authorized the Department of Interior to carry out soil and water conservation measures on the public domain lands. Unfortunately, the funds made available for this work have been very inadequate.

Other Relationships

A number of other major problems in water use or in water-land relationships have been recognized in Federal legislation. Drainage of swamps and marshes, diversion of water for irrigation uses, and various other disturbances have in many places wrought havoc on the feeding grounds and nesting places of waterfowl. This problem has international ramifications because the United States has bound itself by treaty to maintain suitable habitat for migratory waterfowl. Consideration of the effects upon wildlife and fish is an important aspect

of water-resource management planning. But it is still inadequately recognized in Federal legislation on water matters.

Related to the wildlife preservation problem, and also to use of water for domestic and industrail consumption and for recreation, is the matter of pollution. Here the Federal Government has, as yet, assumed very little responsibility. The more vigorous action has been taken by the States--with some technical assistance by the Federal Government.

Efforts To Obtain Proper Coordination

Thus far, we have been concerned with the efforts made by Congress to develop multiple-purpose projects and to recognize water-land relationships in water-resource planning. It is, however, one thing to authorize multiple-purpose planning, but something else to accomplish it when the legal responsibilities for various functions are so widely scattered among bureaus and departments of the Federal Government, as well as among the States. The coordination of investigations and planning, within the Federal Government and between the Federal Government and the States, is still a problem only partially solved. Several substantial attempts have been made.

Tennessee Valley Authority

The first of these was the establishment of the Tennessee Valley Authority in 1933. In this case a special Federal agency was given authority and funds to do a comprehensive river basin job in the development and conservation of water and land resources. On the whole, the accomplishments of TVA have been impressive. There is considerable support for the idea of creating somewhat similar agencies in the Columbia and Missouri River basins. The President has so recommended but Congress has not yet been disposed to agree with him.

National Resources Planning Board

Another effort to obtain coordination of Federal planning activities, with various amounts of State cooperation, began in 1933 with the establishment of the National Planning Board of the Public Works Administration. This agency evolved into the National Resources Committee made up of the Secretaries of Interior, Agriculture, Commerce, Army, Labor, and several other similar officials. The functions performed by this Committee were later transferred to the National Resources

Planning Board in the Executive Office of the President. For various reasons this agency was abolished by Congress in 1942.

Federal Inter-Agency River Basin Committee

The abolition of the National Resources Planning Board (along with its regional offices that served as secretariat for a number of State Planning Board associations such as the New England Regional Planning Commission) did not lessen the need for the coordination of Federal water-resource programs at the national and regional levels. Nor did it do anything to satisfy those critics of the Executive Branch of the Government who lay so much emphasis on "duplications, conflicts, and overlapping" in Federal administration.

Pressure of this type of criticism, coupled with the experience that had been gained earlier, prompted the Federal Departments, in 1945, to set up an informal committee through which limited consultations might be carried on. This has come to be known as the Federal Inter-Agency River Basin Committee. It includes representatives of the Departments of Interior, Agriculture, Army, Commerce, Federal Power Commission, and Federal Security Agency. Its principal function is to consider and reconcile--if possible--various conflicts that have arisen in connection with the planning of programs for river basin development. This Committee has no authority to require compliance with its decisions. It has no staff to make studies of its own. It has, however, established some subcommittees that have done special jobs. One of these pertains to the methods and principles employed in the economic analysis of river basin projects.

Realizing that the coordination job cannot be done entirely in Washington, D. C. but must be extended to the grass roots, the Committee has slowly moved to meet problems at the regional level. Inter-Agency River Basin Committees have now been established in the Columbia River Basin, in the Colorado River Basin, in the Missouri River Basin, in the Basin of the Arkansas, Red, and White Rivers, and very recently in the New England-New York area of the Northeast. We shall have more to say about this last committee a little later.

These various regional committees are composed of one representative from each of the six agencies participating in the Federal Inter-Agency River Basin Committee. These regional representatives are appointed by the respective agency heads (Secretary of Army, Secretary of Interior, etc.) to whom they report directly. Each regional representative

is authorized to call upon bureaus of his Department for such cooperation as can be given under existing legal authority. The Departments of Agriculture and Interior have each found it desirable to organize an inter-bureau "Field Committee" to facilitate the work of the Departmental representative.

The Federal Inter-Agency River Basin Committee has invited the Governor of each State within each respective region to designate a representative to sit with the regional committee. This invitation has been accepted in all instances. A certain degree of Federal-State cooperation is thus obtained.

While this coordinating mechanism is the best that can be devised under present law, it is little more than a loose consultative arrangement.

The New England-New York Comprehensive Survey

Failure of New England to keep pace with the industrial expansion that has characterized the country as a whole, plus continued existence of chronic localized unemployment conditions, has led to considerable public concern about this matter. Various agencies within New England have studied the problem during the past several years. One proposal that was submitted for Congressional consideration would have set up a New England-New York Resources Survey Commission authorized to make a full-scale investigation of multiple-purpose resource development with participation by the Federal agencies and the States concerned.

The Rivers and Harbors and Flood Control Act of 1950, as finally passed by the Congress, simply authorized the Department of the Army to "survey the Merrimack and Connecticut Rivers and their tributaries and such other streams" in New England "where power development appears feasible and practicable, to determine the hydroelectric potentialities, in combination with other water and resource development."

In giving his approval to this legislation, the President sent a message to Congress commenting on what he regarded to be serious deficiencies in the Act. With respect to this particular authorization he said:

> This assignment of responsibility...obviously involves the work of other Federal agencies, and of the States, as well as that of the Department of the Army; and those other agencies and the States should participate in the planning work.

> In this case, moreover, the act does not specify the several other purposes, aside from the development of power, which should be considered in order to prepare proper resource development plans.
>
> And yet soil, forest, and fisheries conservation and management, stream pollution abatement, improved domestic and municipal water supplies, recreational development, and other resource problems, are all highly important to the future growth of the Northeastern States....

The President went on to inform the Congress that he proposed to use his existing powers to see that all of the Federal agencies concerned, and the States, should participate in the New England survey. He also ordered that its scope be broadened to include the State of New York.

Following up this announced intention, the President instructed the Departments of Army, Agriculture, Interior, Commerce, the Federal Security Agency, and the Federal Power Commission to organize a temporary inter-agency committee for the purpose of initiating a comprehensive survey of the resources of the region. He designated the Department of the Army as chairman agency of this temporary committee. The President's directive went on to say:

> Each agency and the committee as a whole should coordinate its plans and activities and those of interested State and local agencies. The State and local agencies have a direct and vital interest in the conduct of this investigation and the report that will result. Many of the existing activities of State and local agencies in the resources field should fit into the project investigation. I am sure that State and local agencies will be anxious to cooperate. In order that they be afforded every opportunity and encouragement to participate in the work of the committee, I am asking the Governors of the seven States concerned to designate official representatives to act as liaison between the committee and the various State agencies concerned with resource development. In addition, I want the committee to invite the ideas and help of local governments and private groups and individuals to the extent possible. It is

essential that the Federal agencies draw upon the experience and ideas of the people of the region to the fullest extent and that the final report carry the concurrence or comments of each affected State.

The comprehensive study of land and water resources of this area should include, among other matters, coverage of electric power generation and transmission, forest management, fish and wildlife conservation, flood control, mineral development, municipal and industrial water supply, navigation, pollution control, recreation, and soil conservation. The necessary first step in such a study is an inventory of the land, water, and all of the related natural resources available for utilization, together with a survey of the projected regional and national requirements which might be met through more effective utilization of the natural resources of the region. When these basic facts on resources and needs have been collected and analyzed, the committee should then proceed to determine what development and conservation projects are feasible and desirable, and to prepare recommendations for specific action to carry them out.

In accordance with these instructions, the New England-New York Inter-Agency Committee has been set up with headquarters in Boston. The first official meeting was held recently. Monthly meetings and a series of public hearings have been scheduled.

Subject-Matter Content Of The Survey

Complete details of the specific studies that will be carried on have not yet been fully determined. There will, however, be a general over-all report covering all the matters touched upon in the President's directive. In addition there will be a series of special reports covering subjects such as: (1) flood control, waterflow retardation and erosion prevention; (2) potentialities for the development of hydroelectric power, and of power markets; (3) a program for the development of agricultural resources, including forest resources; (4) a program for the improvement of inland navigation; (5) a program for development of mineral resources; (6) a program for the improvement of recreational facilities and opportunities;

(7) a program for the control of mosquitoes and other insect pests; (8) a program for the reduction and control of water pollution and salinity; and (9) an analysis of the general economic problems and prospects of the region.

The full details of the Station's responsibilities in this survey are not yet fully known. Studies in which it is sure to participate include flood control and waterflow retardation, and the program for agriculture and forestry. Basic data for these studies will be drawn from the Forest Survey, from the Flood Control Survey, and from various forest influences, forest economics, forest utilization and forest management projects.

A MORE DETAILED ACCOUNT OF THE STATION'S WORK

The pages that follow describe the various activities of the Station in the fields of forest management, forest genetics, forest influences, forest-resource surveys and economics, flood-control surveys, and forest utilization.

CUTTING AND LOGGING PRACTICES

and other aspects of forest management

MANPOWER CAN BE CONSERVED THROUGH IMPROVED LOGGING METHODS

HOW TO USE MEN more productively in essential work is an important objective of the Nation's current mobilization effort. Lumber and other forest products loom large in the defense program, yet in the Northeast mechanization of woods work has lagged somewhat behind the progress made in other forest regions. Preliminary results from studies on two experimental forests indicate that comparatively simple improvements in logging methods and crew organization can increase production appreciably on small operations.

On the Massabesic Experimental Forest, changing from 2-man to 1-man power saws for felling and bucking white pine reduced the time required per thousand feet of logs by one to one and a half man-hours. On pilot-operation cuttings the logging crew was first set up on the conventional pattern, two men handling a power chain saw and a third limbing and marking log lengths. Later, when a 1-man saw became available, one man used it alone for felling, and bucking and did his own limbing. Working in this way, even in blown down and jackstrawed timber, his production rate per man-hour was consistently above that attained with the 2-man saw. The trend seems to hold through a range in timber size from 11 logs per thousand feet to 26 logs per thousand. Although the savings per thousand feet need further checking it seems likely that the 1-man saw has a distinct advantage in small to medium size white pine. Commercial loggers in the vicinity of the Experimental Forest are switching over to this simpler and more productive method.

On the Fernow Experimental Forest, power saws for felling and bucking, and tree-length logging with tractor-drawn sulky, gave about 25 percent greater production than the conventional cross-cut saws and ground-skidding with teams. By logging tree lengths and bucking at the truck-loading point, a

number of operations were eliminated such as dogging logs together in the woods and removing the dogs at the landing. On the Fernow Experimental Forest, as on the Massabesic, 1-man power saws were found to be more productive than 2-man saws in cutting small trees for mine timbers.

Conservation of manpower is not solely a matter of obtaining increased production. The logging industry is one of the most hazardous in the country, with a lost-time accident frequency of more than 90 per million man-hours worked. Accordingly, safer methods and equipment are also being studied and developed on the experimental forest pilot operations.

IMPROVED CUTTING PRACTICES TO CONSERVE THE FOREST RESOURCE—COSTS AND RETURNS

It is commonly conceded that the emergency for which the country is now mobilizing will not be of short duration, but rather is likely to stretch over a number of years. The emphasis, therefore, is on husbanding and strengthening resources for the long pull ahead. Forests are one of the major resources of the country that respond readily to conservation efforts with increased yields of better products. Results from large plot studies on six experimental forests during the past year show that improved cutting practices that leave the forest in productive condition need cost little, if any, more than destructive practices.

It is well known and generally accepted that a large proportion of the present growing stock of the forests of the Northeast is made up of low-value or worthless trees. Some of these are hopelessly decayed or decadent holdovers from earlier cuttings, some are of poor form though sound, and some are of species not merchantable now nor likely to become so. Forest economists and silviculturists agree that one of the region's more pressing problems is how to replace the low-value components of stands with better growing stock. Information from experimental forest cuttings during the past year casts some light on the subject.

It seems clear that the common practice of liquidating all merchantable growing stock in one cut is generally poor silviculture and bad forest management, profitable though it may be for a logging operator. But whether better silviculture is financially feasible, and how much better silviculture is financially feasible, have been debated at length.

Nearly all loggers and most forest owners have contended at one time or another that they cannot afford to use cutting and other silvicultural practices better than those aimed at liquidation of most if not all of the merchantable growing stock. Computations and analysis based upon results of small plot studies of the past have seemed, to silviculturists, to show that better cutting practices are not only feasible but in the long run more profitable for owners. Testing this hypothesis on a pilot-operation scale is an important part of the Station's program of forest-management research.

Preliminary to beginning compartment-size pilot studies in timber management on six experimental forests, selected plots were cut under high-order, good, and fair silviculture, and under ordinary poor practices that embody no silviculture. The plots ranged in size from 5 to 8 acres each and totaled for all the experimental forests nearly 40 acres for each intensity of practice. Their primary purposes were to train experimental forest personnel and to serve as illustrations of the cutting practice levels appropriate to the forest type in question; but in addition they have yielded preliminary data of interest on growing stock left after the initial cut, the cost of logging, and the net income remaining to cover stumpage, etc.

One of the earmarks of the progression from poor to better cutting practices in northeastern forests is the leaving of larger growing stocks made up of a high proportion of the better trees. Table 1 shows the volumes of growing stock left under each of the levels of cutting practice on five of the sets of plots.

On the Beltsville Experimental Forest, seed trees were left under the fair level of cutting practice; the good and high-order cuttings were shelterwoods. On the Fernow, Paul Smith, Penobscot, and Pocono Experimental Forests the selection system of silviculture was used. The post-logging stand data for the Penobscot are not yet available. On the Massabesic Experimental Forest, seed trees were left under the fair level of practice while the good and high-order practices were light intermediate harvest cuts. On all experimental forests the poor practice removed all or nearly all merchantable trees. Volumes left under the poor cutting practices were chiefly in trees just below merchantable size or of species not being taken in the particular operation.

Table 1.--Growing stock per acre after cutting

Experimental forest	Forest type	Level of cutting practice			
		High order	Good	Fair	Poor
		Cubic feet	Cubic feet	Cubic feet	Cubic feet
Beltsville	Virginia pine	900	321	61	0
Fernow	Appalachina hardwoods	1,347	1,713	1,060	0
Massabesic	White pine	2,343	2,242	878	304
Paul Smith	Adirondack spruce-fir	1,308	1,150	606	498
Pocono	Northern hardwoods	1,612	1,665	1,136	252
Average	—	1,502	1,418	748	211

Logging costs generally went up with increasing amounts of growing stock left; that is, costs varied inversely with volumes cut. This was not true on the two pulpwood cuttings (Beltsville and Penobscot Experimental Forests) where the lighter cut of larger material on the good and high-order levels was logged more cheaply than when small trees were also cut under fair and poor practices. Table 2 shows the logging costs of the higher levels expressed as percentages of those for poor cutting practice. The striking thing is that, for all the experimental forests, the spread in logging costs is quite moderate. Differences as great can readily be found between operators and logging chances.

When costs other than logging and differences in value of material cut were taken into account, the net amounts per M board feet available for stumpage and margin for profit and risk were obtained as shown in table 3. Because of differences

in methods of disposing of the timber the net values given are not all based upon the same cost elements. On two experimental forests final cost figures on some items are not available, so values cannot be given. The net values given are for the experimental forests from which all data are available.

Table 2.—Logging costs of higher levels of cutting practice in percent of those for poor practice

Experimental forest	Level of Cutting Practice			
	High Order	Good	Fair	Poor
Beltsville	81[1/]	91[1/]	108[1/]	100[1/]
Massabesic	134	137	89	100
Paul Smiths	149	133	127	100
Penobscot	89	88	102	100
Pocono	132	130	119	100
All	120	117	111	100

[1/] Based upon man-hours of labor only.

Broad generalizations from the data presented are not justified, because of the small size of the plots and the element of training that entered into the cutting of them. Yet it is worth noting in table 3 that the fair level of cutting practice showed up a little better than did the poor in all except on one experimental forest. There is indication, too, that the forest owner who wants to make a light cut—taking out the poorer elements of a stand—should be prepared to accept low stumpage rates at the start; in extreme instances perhaps none at all. The favorable showing made by the good level of cutting encourages the thought that improvement cut-

tings a little below the silviculturists' ideal are likely to prove modestly profitable for even the initial cut as well as highly beneficial to the future productivity. More reliable checks on these first exploratory results will flow from the larger compartment pilot-operations in subsequent years.

Table 3.—Net amounts available per M board feet for stumpage plus margin for profit and risk under different levels of cutting practice

Experimental forest	Level of cutting practice			
	High Order	Good	Fair	Poor
Fernow	$ 0.88	$ 6.62	$12.30	$10.03
Massabesic	10.31	10.01	14.52	13.50
Paul Smith	7.94	11.18	15.51	21.97
Pocono	1.30[1/]	3.85[1/]	3.96[1/]	2.74[1/]

[1/] Per ton, green weight. Material cut chiefly for mine timbers.

THE OUTLOOK FOR LABOR RETURNS FOR THE OWNER OF SMALL FORESTS

In the Northeast a vast total acreage of forest land is held in small ownerships and, as in other regions of the country, the cutting practices being applied to the small forests are characteristically poor. There may be many reasons why these forests are badly managed, but one of the more obvious is that owners have not been convinced that better cutting and management is financially feasible. If that can be shown, it is believed that many owners would be ready to have their properties cut in accordance with good forestry principles.

The need for such information by major forest types is present throughout the Northeast; so on each active experimental forest one or more "small forest" areas are being devoted to the problems peculiar to managing small forest properties. Cutting is planned to yield income at short intervals, preferably annually. Growing stocks are to be improved in both quality and quantity where needed. Cultural measures likely to be profitable will be used. And records will be maintained, both financial and physical, to determine the practicability as well as the profitability of the venture. The results will therefore be illustrative of what an interested small owner could expect.

Three of these "small forest" areas of about 35 acres each received their first cuts during the year. Two are on the Pocono Experimental Forest and are representative of second growth in the northern hardwood type in the Anthracite Region, one better than average in current stocking and quality of stands, and the other poorer. The third is on the Massabesic Experimental Forest and is perhaps a little better than the average white pine woodlot. In all three however, the crying need was for improvement cutting; so this first year the cuts were made up from the poorer trees and from thinnings, and the same thing probably will be done for the next several successive cuts. The logging of the initial cut was done with teams and such equipment as a farmer might have.

All three operations yielded fair to good wages after deducting for taxes and nonlabor logging costs such as team hire, power saw rental, small tools, etc. The allowance for taxes for each "small forest" was made in accordance with local rates. No "stumpage" allowance is shown in the tabulations below; the trees cut were generally of poor quality and their removal resulted in an improvement of the growing stock left. Also omitted from the calculations are other items of cost such as administrative expense, margin for profit and risk, and compensation insurance, that are a regular part of industrial accounting. They are not very important in present instances because the owner of a small forest property who could use his own labor is likely to be interested mostly in how much net cash he could get for his labor.

How each of the three initial operations paid out in wages per man-hour of labor is shown below.

On the Pocono Experimental Forest

For a small forest with better-than-average stand (202 man-hours at $0.671 per man-hour)—

Gross income	
Fuelwood, 8 cords	$80.00
Mine props, 1,371 linear feet	75.23
	$155.23
Costs other than labor	
Taxes	4.52
Logging	15.05
	$ 19.57
Net income	$135.66

For a small forest with poorer-than-average stand (258 man-hours at $0.568 per man-hour)—

Gross income	
Fuelwood, 8 cords	80.00
Sawlogs, 80 board feet	2.80
Mine props, 1,992 linear feet	97.41
	$180.21
Costs other than labor	
Taxes	6.60
Logging	28.15
	$ 34.75
Net income	$145.46

On the Massabesic Experimental Forest

For a small forest with better-than-average stand (142 man-hours at $1.33 per man-hour)—

Gross income	
12,700 feet at $23.00	$292.00
Costs other than labor	
Taxes	60.00
Logging	43.80
	$103.80
Net income	$188.20

These returns are not spectacular. But then, neither are the forests from which they were obtained nor the materials removed from them. The encouraging and significant lesson learned from these operations is that the first steps toward bringing a small run-down forest to improved productivity can pay a reasonable labor return rather than result in a net loss.

CONTROLLING THE COMPOSITION OF NORTHERN HARDWOODS REPRODUCTION

The composition of reproduction following harvest cuts is a matter of real concern to the forest manager. Too few stems of the species he wants forces a choice between expensive planting and acceptance of reduced income from the next crop. Or, if there are enough stems of the desired species but they are overtopped by less desirable ones, the choice again lies between an increased investment in a release cutting or acceptance of a less valuable crop. An experiment on the Bartlett Experimental Forest has shown how harvest cuttings may influence the composition of regeneration in the northern hardwoods type.

The experiment was begun in 1933 in uneven-age stands of northern hardwoods in which beech predominated. Three areas were cut over; one was entirely clear-cut, one was cut in patches ranging in size from 0.1 to 0.6 acres, and on the third approximately 30 percent of the basal area was removed in a selection cut. Permanent milacre quadrats were laid out, and the advance reproduction present was tallied. In 1949, 15 years after cutting, the reproduction on these same milacres was examined. The dominant-tree species on each quadrat was recorded and also the species of the crop tree present if the dominant tree was not a desirable crop tree. The data thus gives a picture of what happened to the advance reproduction of the stand, the composition of the stand that will develop without further help, and an indication of the size of the release job that might be undertaken.

The composition of the reproduction before cutting and 15 years later is given in table 4. There was least change in composition following the light selection cut. The percentage of beech decreased about a third, that of sugar maple increased by a third, and a few yellow birch and white ash became established. Sugar maple, beech, and striped maple still make up the bulk of the reproduction as they did before

cutting. In the patch cuttings and the extensive clear-cutting advance reproduction was less important in determining the present composition of the new stand. In the cleared patches the proportion of sugar maple and beech dropped slightly but yellow birch and white ash seeded in effectively, paper birch somewhat less so. On the extensive clear-cut area the composition of the advance reproduction had little relation to the present composition. Paper birch is now present in good numbers, with yellow birch and ash in smaller amounts. There are only about one-third as many sugar maples and beeches now as before cutting. Aspen and pin cherry seeded in abundantly and now overtop other trees on almost half of the milacres.

Table 4 does not, however, tell the whole story. On many of the quadrats where a weed species such as aspen or pin cherry is dominant, there is a potential crop tree of a desirable species present beneath it. Adding the number of such quadrats to those on which timber species are dominant, we find about 90 percent of the quadrats on the extensive clear-cut area and in the cut patches have at least one good tree of timber species. A tree, to be considered a potential crop tree, had to be 6 feet or taller in 1949. About 10 percent of the quadrats had no trees or only those of inferior species unsuitable for crop trees. On the selection area striped maple is the only dominant weed species but a large number of the quadrats were blank, so that only a little less than two-thirds of the quadrats had desirable crop trees.

When the percentages in table 4 are translated into number of stems per acre it can be seen that under each of the methods of cutting there would be more than 300 trees per acre of yellow birch, paper birch, sugar maple, and white ash that are dominant and can be expected to make up the final stand. If, in addition, beech and red maple are accepted as satisfactory crop trees, all three areas can be considered as adequately stocked, with about 500 or so dominant crop trees per acre. On the clear-cut area and in the patch cuttings, removal of some of the overtopping weed trees might be desirable to release still other crop trees. On the selection area, where more reproduction can be expected after the next cyclic cut, and where weed species are less troublesome, release cuttings are not needed now.

Table 4.--Percentage of milacre quadrats by dominating species, before cutting (1933) and 15 years later (1949)

Species	Clear-cut (Basis 435 milacres)		Patch cut (Basis 972 milacres)		Tree selection (Basis 597 milacres)	
	1933	1949	1933	1949	1933	1949
Yellow birch	1	6	2	16	—	3
Sugar maple	21	8	10	9	21	29
White ash	—	3	—	6	—	1
Paper birch	—	16	—	2	—	—
Beech	40	13	30	28	33	23
Red maple	—	2	—	4	—	—
Aspen	—	10	—	—	—	—
Striped maple	9	2	13	11	10	12
Pin cherry	—	32	—	6	—	—
Softwoods, blanks, miscellaneous	29	8	45	18	36	32
Total	100	100	100	100	100	100

REGENERATION OF BLACK CHERRY

Black cherry is a prominent and valuable component of second-growth stands on large areas of the Allegheny Plateau in Pennsylvania and New York, but is notably scarce in the third-growth stands. Loss of black cherry is a matter of particular concern to the Allegheny National Forest and to private forest owners in the vicinity, so surveys of the results of past cuttings have been conducted for the past 2 years in a search for guides to cutting practices that will assure regeneration of the species.

The survey followed the stocked-quadrat method with 0.004-acre quadrats spaced on lines. Thirteen different age and stand conditions were sampled and observations were made

on 480 quadrats. Black cherry seedlings less than a full year old were not considered as established and are not included in the stocking figures below.

Black cherry seeds regularly and well, and established seedlings were found rather generally except in old growth or unthinned second-growth stands, where none were found. But it dominated (in its own size class) only 6 percent of quadrats in thinned second growth (which included, of course, species other than cherry). Large-scale clear-cuttings had cherry dominant on only 28 percent of the quadrats and much of this was of sprout origin and poor quality. Only two situations seem to favor the formation of desirable third-growth stands dominated by cherry; (1) narrow strip cuttings in 40-60-year-old second growth; and (2) small group openings in second growth cut to diameter limits of 8 inches or less. In both situations close utilization seems to favor cherry by reducing competition from sugar maple, beech, and other tolerant species. Narrow strip cuttings 5-26 years old had 63 percent of quadrats dominated by black cherry. In diameter-limit group cuttings 44 percent or more of the quadrats had cherry dominant. Translated into numbers of trees these percentages indicate about 150 and 100 trees per acre respectively.

These levels of stocking by no means assure that pure stands of cherry will follow. Nor is that to be desired, for black cherry is susceptible to glaze damage, and glaze storms are fairly common at the higher elevations of the Allegheny Plateau. Moreover, some cultural work will probably be required to help cherry maintain its position against fast-growing stump sprouts and weed species. And after the first 10 years additional heavy cuts will be required on areas cut to diameter limits to prevent suppression of cherry by the expanding crowns of the trees left.

During the year, in cooperation with the Allegheny National Forest and the Armstrong Forest Company, establishment of experimental strip cuttings, and of release cuttings in 10-year-old third-growth stands, were made.

POISONS FOR STAND-IMPROVEMENT WORK

Widespread and lively interest in the use of herbicides and silvicides for stand improvement, planting-site preparation, and general control of woody vegetation continues. A number of agencies in the Station's territory are studying the effects and effectiveness of 2,4-D (2,4 Dichlorophenoxyacetic

acid) and 2,4,5-T (2,4,5 Trichlorophenoxyacetic acid) and their derivatives as well as Ammate (ammonium sulfamate) and other materials. The Station's studies have been directed chiefly toward the use of the poisons for eliminating unwanted growing stock, controlling stump sprouting, and reducing scrub oak competition on areas to be planted.

Preliminary compilation of the results of 3 years' tests on beech, sugar maple, and yellow birch at the Adirondack Research Center show that sodium arsenite is more effective than Ammate in killing trees above pole size when both were applied as solutions in holes bored tangentially and downward around the bole. Applications made in July and August were most effective; dormant-season use is relatively ineffective. Fifty-percent solutions were almost twice as effective as those of 23 percent, and for reliable results should be applied in holes bored not more than 8 inches apart. Ammate was found to be reliable only on beech and when applied during July and August as a 50-percent solution in holes bored 4 inches apart.

On the Pocono Experimental Forest, however, Ammate applied in cups chopped in the base and main roots of stumps of beech, red maple, and a few sugar maple, striped maple, yellow birch, and black cherry was effective in preventing sprouting. So also was spraying stump sprouts with Ammate solution (4 pounds per gallon) and spraying with Weedone Brush Killer 34 in diesel oil (1 part in 20). All treatments were made in early September.

In the Pocono experiments several beech saplings and poles near notch-treated beech stumps died, apparently as a result of translocation of Ammate through root grafts. Similarly situated beech root suckers were seemingly unaffected.

Cost data on use of the Ammate-in-basal-notch method of poisoning unwanted growing stock were obtained on the Pocono Experimental Forest. In poisoning 766 such trees on an area of 24 acres the men averaged 19.2 trees, or 158 cubic feet, per man-hour. One pound of Ammate was used to poison 94 cubic feet of standing trees. Cost per tree varied inversely as tree volume. Total cost was $1.86 per acre.

On the Lebanon Experimental Forest Ammate was slightly less effective but much cheaper than Weedone Brush Killer 32 (2,4-D and 2,4,5-T) in kerosene for preventing sprouting of freshly cut oak stumps. Of such stumps poisoned with Ammate in November, 87 percent failed to sprout the following spring. From other exploratory trials, sweetbay seemed most susceptible

to Ammate, followed by blackgum, the oaks, and red maple. Black, chestnut, post, and white oak appeared equally susceptible. When standing trees were poisoned with Ammate in basally chopped cups all untreated companion sprouts of sweetbay died as did most of those of the oaks. In red maple two-thirds of the untreated companion sprouts showed little or no damage.

Ammate solution was also more effective than formulations of 2,4-D and 2,4,5-T in killing scrub oak and related vegetation for planting-site preparation at the Anthracite Research Center. The solutions were applied with a Jeep-mounted power sprayer. The Ammate treatment costs were, however, appreciably higher than those of bulldozing shallow furrows for planting.

PROGRESS ON SCRUB OAK CONVERSION STUDIES

The search for a cheap, easy, and effective method of reclaiming for forest production areas now covered with scrub oak received some setbacks during the year but made some advances also. Plantings made in 1949 in wide, shallow bulldozed furrows suffered heavy losses from frost heaving. On one area 48 percent of all trees had been heaved and on another 16 percent. Lack of snow cover during early winter contributed largely to the damage. In addition, the plantings were browsed by deer. At Bear Creek 14 percent of the trees were browsed, and on the Game Lands 45 percent. Between the two sources of damage the percentage of trees originally planted and still in fair to good condition averages only 30 on the Bear Creek area and 37 on the Game lands. None of the nine species survived appreciably better than the others. The species tested were black locust, red oak, white pine, Scotch pine, jack pine, pitch pine, European larch, Norway spruce, and red pine.

Tests of planting in the wide bulldozed furrows were continued in cooperation with the Pennsylvania Department of Forests and Waters, however, on a 50-acre area on the Delaware Lehigh Experimental Forest—to get cost data as well as survival and growth information. Total costs per acre were $25 when the bulldozer was manned with an efficient operator. The cost per acre for furrowing was almost $2 per acre higher with the less efficient operator than with the better one. With the furrows spaced about 9 feet apart site preparation cost $11.52 per acre, planting $9.62 (wages 94½ cents per hour), and stock $4.22 ($6 per M).

Because even the wide shallow furrows employed carry the threat of erosion and rapid runoff they were broken at short intervals by lifting the dozer blade. As additional precaution the furrows were laid out on contour.

As mentioned elsewhere in this report, Ammate was the only one of several silvicides tested that gave satisfactory control of scrub oak and associated vegetation. The cost, however, was well above that of preparing the site by bulldozing furrows. Moreover, planting in the poisoned areas was very difficult. It was hard work to drive a planting mattock through the undisturbed 6-inch-thick root mat, and tedious to put the seedling roots properly in the planting slit. The presence of the stiff brush stems was also a decided hindrance to the planters. At present, therefore, the earlier promise that silvicides seemed to hold is fading.

A demonstration of the Seaman Tiller on the Delaware-Lehigh Experimental Forest has stimulated interest in its possibilities for site preparation on areas not too rocky. A series of revolving teeth on the machine chew up the tops and roots of the brush and thoroughly mix the debris into the soil. The surface of the tilled strip, about 6 feet wide, is left relatively smooth. The advantages of the process are that it avoids water-concentrating furrows, retains the organic matter where it will be most beneficial, avoids the need for planting on raw subsoil, and apparently gives fair to good control of scrub oak. It will be tested more extensively in 1951.

STATUS OF THE SPRUCE BUDWORM EPIDEMIC AND PROGRESS IN BUDWORM RESEARCH

The Canadian forests are still bearing the brunt of the spruce budworm attack. Its steady advance eastward in continuing. Heavy infestations now occur in the Laurentides Park and as far east as points beyong the Saguenay River in Quebec Province. Large areas of infestation are also developing in northern New Brunswick. It appears now that only the Atlantic Ocean can halt the eastward spread. The continued eastward advance of the insect greatly increases the chances of large-scale moth flights into northern Maine. Fortunately up to the present no such mass flights have been detected. However, on August 13, 1950, vast swarms of budworm moths decended on Quebec City, less than 60 miles from the Maine border.

The situation in Maine looks none too promising. The 1950 ground survey, undertaken by the Bureau of Entomology and Plant Quarantine in cooperation with the Maine Forest Service, showed an increase over 1949 both in distribution and intensity of build-up of the budworm in the northern part of the State. The most striking increase in area was noted west of the St. Johns River. This infestation now extends north across the state boundary to the St. Lawrence River, linking this infestation with the outbreak in Canada. In western Maine, fortunately, the budworm population is remaining at a low level and only scattered specimens were found in the eastern part of the state. Similar surveys conducted in New York, Vermont, and New Hampshire indicate extremely light infestations with no trace of defoliation.

Determination of the extent and intensity of budworm infestations by use of aircraft is proving to be quite feasible. Federal and State entomologists used this scheme last year in the preparation of a budworm infestation map for Maine. East-west flight lines traversing the spruce-fir region of the state at intervals of 3, 6, and 10 miles were made. The survey, based on detectable budworm defoliation as observed from a plane, was completed in the short period of 2 weeks. It was supplemented by ground checks to verify aerial observations. This survey disclosed that defoliation was present on approximately 4 million acres. Continuous defoliation occurred on 560,000 acres; on the remaining 3,440,000 acres damage consisted of scattered defoliated trees.

Little encouragement can be derived from the egg-mass surveys conducted in Maine in 1950 by State and Federal entomologists. Egg mass counts, reduced by natural factors of control, have proven fairly reliable indices of the succeeding year's larval population. The 1950 survey points to a continuing build-up of budworm population in northern Maine. However, State and Federal entomologists believe that the infestation will not be heavy enough in 1951 to cause serious damage over extensive areas.

A gigantic struggle apparently is in progress in Maine between the spruce budworm and its natural factors of control. Last year's mortality studies show that the budworm sustained enormous losses from the time the eggs hatched in 1949 to the full larval stage in 1950. The importance of natural control was clearly demonstrated in the Adirondack outbreak of 1945. By 1948 this menace was brought under complete control by natural factors. Parasites get in their deadly work at the very beginning, preying not only on the eggs and pupae but on

the larvae from the time they leave their hibernating quarters until they are full grown. Winter mortality, virus diseases, and insectivorous birds also make heavy inroads. The impact of these forces thus far has kept the population in Maine down to a level where damage from the insect has not been excessive. Should these factors be less effective this winter and spring, serious defoliation could develop in 1951. The threat of a serious outbreak in Maine continues. There is always the possibility of a heavy flight of moths from Quebec as long as the budworm outbreak persists there. Thus there is every good reason for continuing preparations to combat the pest with every practical means at our disposal.

Experimental aircraft spraying for control of the budworm was undertaken in 1950 in northern Maine to determine the effectiveness of DDT formulations. This was a cooperative project between the U. S. Department of Agriculture, the Maine Forest Service, and private timberland owners. A series of 16 ten-acre plots was sprayed, using emulsion and solutions of various formulations. Preliminary analysis indicates little difference in effectiveness of control between solution and emulsion sprays. DDT solution applied as a fine spray gave best results.

The sixth annual inspection by the Northeastern Station of the experimental budworm cuttings near Forbes Depot, Quebec, was made in 1950. Mortality on 23 permanent sample plots examined averaged 58 percent as compared with 28 percent in 1949. Mortality continued to be confined to balsam fir; no losses attributable to the budworm were noted in either black or white spruce. High-vigor balsam fir showed slightly better survival than the lower-vigor trees. Observations thus far indicate that dense stands sustain heavier damage than those moderately well stocked, that stands on well-drained sites suffer less than those on wet sites, and that survival of balsam fir is likely to be higher in mixed stands than in stands of pure softwoods.

Bureau of Entomology plans for 1951 call for continuing both ground and aerial surveys in Maine in cooperation with the Maine Forest Service. Should the budworm population increase to the point where spraying is justified, aerial spraying on a 20-square-mile tract will be undertaken by Federal and State agencies in Maine in cooperation with private industry. In any event, experimental spraying on a small scale is planned to obtain additional information on the timing of spray applications. Studies now under way by the Bureau of Entomology and Plant Quarantine on natural factors of control

will be continued. Re-examination of the Forbes Depot budworm cutting areas is also planned.

EXPERIMENTAL FORESTS DAMAGED BY STORMS

On November 25, 1950, a storm that attained gale intensity over wide areas swept over most of the Station's territory. Damage to forests was widespread and in many localities was severe. In general, overmature and old-growth stands suffered more than younger ones, and conifers more than hardwoods. Damage on the experimental forests ranged widely with some suffering serious injury to their future research values.

The Gale River and Massabesic Experimental Forests were hardest hit. Preliminary estimates are that more than 1,000 cords of merchantable spruce and fir were broken over or uprooted on the Gale River Experimental Forest. Few stands of merchantable size escaped unscathed. On the Massabesic Experimental Forest something over half a million feet of white pine were blown down on the area burned over in 1947. Examination of uprooted trees revealed that nearly all of the supporting roots near the surface had been killed or damaged by fire and were rotted. On the unburned portion of the forest wind damage was negligible, so the heavy losses are properly chargeable to the 1947 fire. On a series of plots in the unburned area damage was roughly inversely proportional to the growing stock left after cutting.

The Penobscot, Paul Smiths, Standing Stone, and Pocono Experimental Forests sustained light to moderate damage. On the Penobscot some 300 cords were windthrown or broken, chiefly balsam fir weakened by butt rot. Some 85,000 board feet were lost on the Pocono, about one-third black cherry, and 5,000 cubic feet in pole-size trees. Standing Stone lost about 80,000 feet of white pine sawtimber (the only white pine stand on the forest) and around 300 cords of pine pulpwood. On Paul Smiths the damage was light and scattered.

The Bartlett, Kane, and Beltsville forests escaped although a few seed trees on a recent cutting at Beltsville were lost. The Fernow was outside the storm area.

It is expected that most of the down timber will be salvaged, either in special cuttings and sales or in the course of planned tests of pilot-operation cuttings. In only a few cases will the damage seriously interfere with current work.

SUMMARY OF SPECIFIC JOBS IN 1950

GROUPED BY UNIFORM PROJECT HEADINGS USED BY ALL STATIONS

Problem Analyses

1. The problem analysis and research program for the spruce-fir region of Maine and New Hampshire was completed.

2. Drafts were prepared of analyses of the problems of forest management for the Adirondack spruce-fir hardwood, northern hardwoods, and white pine problem areas.

3. Began analysis of problems of forest management for the Mountain State (Appalachian hardwoods) problem area.

Harvest Cuttings

1. On the Pocono, Fernow, Bartlett, and Massabesic Experimental Forests, eight compartments were inventoried, marked, and cut under approved pilot-operation plans.

2. Working plans for pilot-operation studies were completed for the Beltsville and Fernow Experimental Forests, and were prepared in draft form for the Paul Smith, Penobscot, and Bartlett Experimental Forests.

3. Made the first cuts on "small-forest" units on the Pocono, Fernow, and Massabesic Experimental Forests.

4. Working plans for small-woodland-forestry studies were approved for the Fernow and were in draft stage for the Beltsville, Eastern Shore, and Penobscot Experimental Forests.

5. Completed cutting of series of cutting-practice-level plots on the Beltsville, Paul Smith, Fernow, Massabesic, and Penobscot Experimental Forests. Cut three of the four plots in the series on the Hopkins Experimental Forest.

6. Completed establishment work on all the areas cut to date to increase resistance of stands to the spruce budworm.

7. In cooperation with the Maine Forest Service marked a 250-acre tract of spruce-fir forest for cutting to increase resistance of the stand to budworm damage.

8. Found further confirmation, from examination of "budworm resistance cutting areas" that windthrow from ordinary

winds is negligible in partially cut spruce-fir stands.

9. Completed a study of differences in solid-wood content of stacked spruce-fir pulpwood cut under four levels of cutting practice in cooperation with the University of Maine.

10. Compiled and analyzed data on control of reproduction composition through methods of harvest cutting in northern hardwoods.

11. Further surveys of cutover stands of Allegheny hardwoods tend to confirm the conclusion that narrow strip cuttings favor black cherry regeneration. Small group cuttings to diameter limits of 8 inches or less also appear to be favorable.

12. Prepared a working plan for and installed a test of strip cutting for black cherry reproduction in cooperation with the Allegheny National Forest.

13. Prepared a working plan for the study of cuttings to release 10-year old black cherry reproduction in cooperation with the Armstrong Forest Company.

Stand Improvement

1. Completed a 3-year study of chemical killing of beech, yellow birch, and sugar maple holdovers. Sodium arsenite was found more effective than Ammate, and summer applications more effective than during the dormant season.

2. Found Ammate crystals used in cups chopped in the base and roots of stumps prevented or greatly reduced sprouting of beech, oaks, sweetbay, red maple, black cherry, yellow birch, and striped maple. Red maple was found to be quite resistant. A few beech trees adjacent to poisoned stumps were killed by translocation of Ammate through root grafts.

3. In a second-growth hardwood stand Ammate crystals were applied in basally chopped cups of cull trees at the rate of 19.2 trees (158 cubic feet) per man-hour. One pound of Ammate poisoned 94 cubic feet of standing trees.

4. Found formulations of 2,4-D and 2,4,5-T (Weedone 32) in oil killed stump sprouts of oak, beech, and other species, and largely prevented resprouting.

5. Prepared draft of a working plan for a study of thinning and stand-improvement measures in young loblolly pine on the Eastern Shore Experimental Forest.

Prescribed Burning

1. Made final pine seed tree cuttings on a series of prescribed burning plots begun in 1936 in the coastal oak-pine type.

2. Collaborated with Rutgers University on a study of changes in minor vegetation and water relations on plots of a prescribed burning study begun in 1936.

3. Prepared working plans for extension of prescribed burning studies to pine-scrub oak and old-field pine stands in New Jersey.

Silvics

1. Completed draft of a short publication on winter injury to conifers caused by dry winds during extreme cold.

2. Found heavy browsing by deer interfering with planting and other regeneration studies on or in the vicinity of the Lebanon, Pocono, Finch-Pruyn, and Kane Experimental Forests. Installed deer exclosures on the Lebanon and Finch-Pruyn.

3. Found Goodrite z.i.p. ineffective for protecting pitch and shortleaf pines from deer browsing over winter in New Jersey. Deer prefer pitch and shortleaf pines less than 1.0 foot tall. Began test of Goodrite z.i.p. for protection of experimental plantings at the Anthracite Center.

4. Installed tests of Forestasan, a German deer repellant, on the Lebanon Experimental Forest and at the Anthracite Research Center.

5. Cooperated with the Bureau of Entomology and Plant Quarantine on planning and initiating studies on control of beech scale through silviculture and forest management.

6. Reexamined plots in Canadian areas heavily infested with spruce budworm since 1944. Although the epidemic seems to have passed its peak, mortality of fir continues to rise. Forty percent of fir is now dead on one area and 58 percent on another. No white or black spruce killed by budworm were found.

Costs And Returns

1. Completed analysis of production-cost data from areas cut to increase resistance of spruce-fir stands to budworm attack and prepared draft of publication.

2. Collected logging and cultural operation costs from eight compartments cut under pilot-operation studies.

Stand Studies In Mensuration

1. Prepared a working plan for and began a comprehensive study of growth of unmanaged spruce-fir stands in cooperation with large timberland owners.

2. Remeasured a series of permanent growth plots in the spruce-fir type in Maine originally established to study budworm damage to second-growth stands.

Tree Studies In Mensuration

1. Completed draft of publication on the growth of cove hardwoods and second-growth yellow-poplar in West Virginia. Growth was found to be well correlated with vigor classes based upon visible characteristics, and to decrease with increasing diameter. Tree height, but not diameter, was found closely correlated with Girard Form Class.

Planting

1. Installed a 50-acre test of planting in wide, shallow furrows in scrub oak made with 70-h.p. tractor and angledozer blade. Summer survival was generally excellent for European larch, red pine, jack pine, and pitch pine.

2. Planted 2.6 acres of scrub oak in openings between clumps but without scalping. About 70 percent of planted trees have fair to good chances to come through.

3. Found various formulations of 2,4-D and 2,4,5-T ineffective for killing scrub oak and associated species as preparation for planting. Ammate spray was effective in killing tops, and sprouts are sparse and weak.

4. Ammate spray was found to be more expensive than tractor furrowing for planting-site preparation in scrub oak areas.

5. A manuscript was prepared for publication on reforestation of strip-mine spoils in West Virginia and is being reviewed.

6. Remeasured 10-year-old plots of a planting study in the spruce-fir type in West Virginia.

7. "Cartridge" plantings of newly germinated white pine in paper containers failed during a severe drought.

8. Reexamined test plantings made in 1938-39 on poor sites in the Allegheny National Forest. Black locust, although badly riddled by borers, was the only species to survive on a heavily burned, dry site subject to heavy damage by deer and rabbits. Deer, rabbit, and frost damage caused failure of hardwoods planted under light aspen-pin cherry cover on a fertile sheltered site.

Reinforcement Planting

1. An experiment with white pine underplanted in a heavily thinned young oak stand was abandoned because of repeated heavy browsing of the planted seedlings by deer.

Direct Seeding

1. A small test of direct seeding of red pine, pitch pine, and European larch in wide, shallow bulldozed furrows was begun in the scrub-oak type.

PLANS FOR 1951

In keeping with the trend of the times, an increasing part of the Station's work in forest-management research will be slanted toward defense needs. For example, cuttings on the pilot-operation studies will be set up to test new and more productive equipment and logging-crew organization. Many of the individual jobs listed below will provide opportunities to devise better ways of doing things or of meeting defense needs for wood without impairing the productivity of the forest. The Station's plans for forest-management research during 1951 are presented below by research centers, and cover studies on and adjacent to the experimental forests. Work in which the Station staff will participate is included as well as that by personnel headquartered at research centers.

Adirondack Research Center, Including Paul Smith and Finch-Pruyn Experimental Forests

1. Complete plans for the pilot-operation study and begin cutting operations. This will be the major activity and will be given first priority.

2. Expand the tree-poisoning study to test poisons other than sodium arsenite and Ammate and methods of application other than by bored holes.

3. Continue study of site classification and evaluation in cooperation with Cornell University.

4. Supervise and check on cutting of hardwoods on Hudson River Lot 7 plots.

5. Determine the extent of damage caused by the storm of November 25, 1950, on the cutting-practice-level plots and carry out the necessary salvage work.

6. Make an extensive examination of the Paul Smith Experimental Forest to determine the damage done by the storm of November 25, 1950, and plan needed salvage work.

7. Prepare an establishment report on the cutting-practice-level plots.

8. Prepare an establishment report on the plot added to the hardwoods method-of-cutting plots on the Finch-Pruyn Experimental Forest.

9. Prepare a manuscript for publication on the results of tree poisoning experiments with sodium arsenite and Ammate.

10. Prepare a manuscript for publication on the effect of winter injury on mortality and growth of Adirondack conifers.

11. Prepare a manuscript for publication on the results of a method of cutting experiment in Adirondack hardwoods.

12. Prepare a progress report on the third remeasurement of the Hudson River Lot 7 cutting plots.

Allegheny Plateau Research Center, Including Kane Experimental Forest

1. Analyze and prepare manuscripts on current activities. These include: (1) diameter-limit pulpwood cuttings, (2) crop-tree weeding study, (3) test plantings of pines, black locust, black cherry, and other hardwoods, (4) saw-log harvest cutting to 16" diameter limit, (5) tree vigor and quality classes for marking Allegheny hardwood-hemlock thinnings.

2. Make 100-percent reinventory and mark old-growth sugar maple-beech stand on 70 acres on Kane Experimental Forest. Arrange for timber sale on areas assinged to 5- and 10-year cutting cycles; these were cut in 1941.

3. Make 100-percent reinventory on 80-acre area established in 1941 to study periodic growth on 3 levels of growing stock left after harvest cutting and on an uncut area.

4. Plan and accomplish cutting of a set of cutting-practice-level plots of 5 acres each on the Kane Experimental Forest. Plans for pilot-operation management studies will be made.

5. Continue study of shelterwood, partial cuttings, and release of black cherry regeneration cuttings on Wolf Run Forest in cooperation with the Armstrong Forest Company of Johnsonburg, Pa.

Anthracite Research Center, Including Pocono and Standing Stone Experimental Forests

1. Finish the report covering establishment and the first cut on the cutting-practice-level plots.

2. Make second annual cuts on the two small-forest compartments.

3. Continue with scheduled pilot-operation cuttings. (Compartments 18, 19, 20, 22, 25, 26 and 32 are to be cut or treated by the end of 1951.)

4. Continue taking essential measurements and records for the Pocono watershed unit.

5. Plan and install additional experiments with chemicals for control of sprouts and beech suckers, and for killing standing trees.

6. Plan and complete essential cultural work on Compartments 27 and 34 (carried over from 1950), and also on Compartments 18, 26, and 32. This involves poisoning cull trees, pruning softwood crop trees, thinning in hemlock thickets, and possibly some planting in rhododendron thickets by the method developed at the Southeastern Station.

7. Install several small deer exclosures with wire fencing to study the effect of deer upon tree reproduction on the Pocono Experimental Forest.

8. Continue observations and maintenance of experimental plantings in the scrub oak type.

9. Cooperate with the State Department of Forests and Waters in a 7-acre test of the Seaman Tiller for planting-site preparation in scrub oak, and in experimental plantings to be made on the tilled plots.

10. Make periodic observations on the efficacy of Goodrite z.i.p. deer repellent, which was applied in October to some of our experimental plantings.

11. Prepare a Station Note covering experiments with silvicides on scrub oak, and one covering the costs of planting in bull-dozed furrows.

12. Supervise sale and cutting of windthrown timber on Standing Stone Experimental Forest.

Coastal Oak-Pine Research Center, Including Beltsville, Lebanon, And Eastern Shore Experimental Forests

1. Reexamine problem analysis and research programs of Lebanon, Beltsville, and Eastern Shore Experimental Forests.

Beltsville Experimental Forest

1. Complete initial harvest cutting on two pilot-operation compartments.

2. Complete working plan for the small-woodland-forestry studies and start cutting these areas.

3. Complete cultural work required on the cutting-practice-level plots and prepare an establishment report on them.

4. Initiate studies of chipped wood and arrange with the Agricultural Research Center for chipped wood tests; explore outlets for fuelwood.

5. Continue nursery work for the genetics project, including propagating and growing hybrid stock of all genera and preparing poplar cuttings for field testing elsewhere.

6. Establish crop-tree and sapling clonal tests of hybrid poplars.

7. Put in the first planting of a hybrid poplar pilot-operation unit.

Lebanon Experimental Forest

1. In the 1936 study of prescribed burning, burn, as scheduled, 10 acres of plots, thus completing the burning treatments of this study; re-tally reproduction on all plots; on the half of each plot uncut to date, mark 10 pines per acre as seed trees; then arrange to have other overstory trees on these 40 acres cut during the winter of 1951-52.

2. Reburn and remeasure plots in old-field pine stands near Salem and Atsion.

3. Complete for publication manuscripts being reviewed, as well as manuscripts on deer repellents, poisoning hardwoods, and field tests of hybrid pines.

4. Continue work with silvicides, starting a study to determine effect of seasons, dosage, and time since cutting on the effectiveness of treating oak stumps.

5. Complete, as planned, present test of "Forestasan" as a deer repellent.

6. Remeasure plots of deer-exclosure study.

7. Complete establishment of prescribe-burning studies in two types of pine-scrub oak stands, and of a prescribe-burning and thinning study in pine stands 21 years old on old-field sites.

8. In cooperation with State foresters begin summarization of data available from state-established plots in Delaware Valley hardwoods--as a basis for determining what additional studies are needed there.

Eastern Shore Experimental Forest

1. Complete and maintain farm-woodlot study as planned.

2. Establish the cutting-practice-level plots in immature loblolly pine, as planned.

3. Prepare working plan and start establishment of study of prescribed burning for hardwood control in young stand of loblolly pine.

4. Cooperate with Maryland Department of Forests and Parks on studies of prescribed burning for hardwood control in merchantable loblolly pine on the Pocomoke State Forest.

Mountain State Research Center, Including

Fernow Experimental Forest

1. Complete problem analysis for forest-management studies.

2. Complete cutting and cultural work on small product pilot-plant compartments.

3. Make second cut on two small-forest areas.

4. Start cutting on saw-timber management compartments.

5. Complete manuscript study of growth of cove hardwood species and second-growth yellow-poplar in West Virginia for publication.

6. Complete manuscript on "Recommendations for reforestation of strip mine spoils in West Virginia" for publication.

Northern Hardwoods Research Center, Including

Bartlett And Hopkins Experimental Forests

Bartlett Experimental Forest

1. Complete working plan for the compartment pilot-operation study.

2. Inventory, mark, and cut compartments scheduled for cutting in 1951.

3. Revise cubic-foot volume tables.

4. Prepare working plan for 4 cutting-practice-level plots, and complete the installation and cutting of them.

5. Prepare a supplement to the 1940 northern hardwoods problem analysis, bringing it up to date.

6. Prepare a comprehensive report on reproduction following different methods of cutting in northern hardwood stands.

Hopkins Experimental Forest

1. Complete cutting of the cutting-practice-level plots.

2. Prepare draft of working plan for farm-forest compartments.

3. Make first cut in the small-forest areas.

4. Plant sapling and crop-tree clonal tests of hybrid poplars.

5. Begin pilot planting of hybrid poplars.

6. Reexamine hardhack conversion plots and prepare progress report.

Penobscot Research Center, Including Penobscot And Gale River Experimental Forests

1. The working plan for the tree-classification study will be revised. Collection of basic data will be started.

2. The study of wind damage in selectively cut spruce-fir stands will be completed.

3. Work on the cooperative growth study will be continued. Recording of initial plot data will be started.

4. A third-year examination will be made of the direct air-seeding tract in Washington County.

5. Examination of budworm damage in the Kabonga district of Quebec for the year 1950-51 will be made.

6. The problem of defining optimum stand structure will be explored further. It is hoped that a definite plan of attack can be drawn up this year.

7. A concerted effort will be made to complete the exploratory stages of the soil-site quality problem and to define some specific studies that will give the needed answers.

8. Permanent study plots will be established on the Macwahoc experimental cutting area, provided this tract is cut in time.

Penobscot Experimental Forest

1. A mosaic of the Experimental Forest will be prepared from aerial photos.

2. A type map will be made from the photos, supplemented by ground checks.

3. The working plan for the pilot-operation study will be completed. Work on this experiment will be started with the inventory, marking, and cutting of two compartments.

4. The working plan for the small-forest management study will be completed. One of the small-forest areas will be inventoried and the first year's cut will be made.

5. The research development and operating plan for the entire Experimental Forest will be completed.

6. Cooperative agreements covering the sale of about 400 cords of wood to be cut from the Experimental Forest will be executed.

7. A preliminary or informal study will be started of the heavily cut-over stands on the forest now apparently supporting only bursh. From the outcome of this exploratory study will emerge information upon which a full-scale rehabilitation experiment can be based.

8. In cooperation with the Department of Forestry, University of Maine, at least two informal studies, one in silviculture and one in mensuration, will be carried out.

9. Tests will be made of the efficiency of power chain saws when used with different size crews and different crew organizations.

White Pine Research Center, Including

Massabesic Experimental Forest

1. Continue necessary cultural work on the Massabesic Experimental Forest.

2. Cut two of the pilot-operation compartments on the Massabesic Experimental Forest.

3. Make the second annual cut of the Massabesic Experimental Forest small-woodland-forestry study area.

4. Salvage the 1950 blow-down timber.

5. Prepare over-all plans for the utilization of the Massabesic Experimental Forest, including reexamination of the pilot-operation plans.

6. Complete preparation of a comprehensive program for white pine forest-management research and the 1950 revision of the white pine problem analysis.

7. Continue field tests of hybrid poplars on the Massabesic Experimental Forest.

8. Develop plans and start field work on the rehabilitation of areas within the Massabesic Experimental Forest.

FOREST GENETICS

a special project in forest management

MARKED PROGRESS was made during 1950 on the testing of hybrid poplars and the breeding of important native forest trees.

HYBRID POPLAR TESTS

Additional clonal field tests were established in 1950 at the Beltsville, Hopkins, and Massabesic Experimental Forests. Of 250 selected hybrids to be tested, 147, 118, and 80, respectively, are now under test at these three localities.

At Beltsville, the more vigorous hybrids have grown to an average height of more than 12 feet in 2 years from dormant cuttings (unrooted stems 12" in length and 3/16" - ½" in diameter). At Hopkins, with a shorter growing season, the average height of the best hybrids exceeds 8 feet in 2 years.

All hybrids are not included in a single test. For this reason it is advisable to base comparisons of growth vigor on a ratio of the height growth of individual hybrids to the average growth of all hybrids in each specific test:

$$\frac{\text{Av. ht. of individual hybrid}}{\text{Av. ht. all hybrids in test}} \times 100$$

The test averages for 2-year-growth at Beltsville are between 8 and 9 feet; at Hopkins the test averages are between 6 and 7 feet. The following figures indicate that more than half of the clones tested for 2 years are above average vigor, and that a relatively large proportion will exceed these average heights by 15 percent or more.

Location	Number of Clones			
	Tested for 2 or 3 years	Above the test averages	15% or more above test average	25% or more above test average
Beltsville	97	54	30	13
Hopkins	68	41	14	7

Cover crop tests.—For several years we have been searching for cover crops which would crowd out detrimental grass and weeds in new plantations without materially retarding the growth of the hybrid poplar. In 1950, field tests were started at Hopkins, Beltsville, and Massabesic with a total of 16 different cover crops. Drought at Massabesic immediately after planting resulted in complete failure of the cover crops; the growth of poplar was somewhat below average. The Hopkins and Beltsville measurements have not yet been analyzed, but all cover crops that gave satisfactory stands appear to have retarded, at least to some degree, the growth of poplar during the first year. Since second-year growth may show some reversals, these observations must be considered entirely preliminary.

BREEDING

The hybridization work was more successful in 1950 than in other years since the war. This was due in part to better acquaintance with the breeding material and in part to more favorable conditions for seed set. Several years' observations on the fruiting behavior of individual trees made it possible to select for working only those trees thought to be most likely to produce seed.

In 1949-50, Pinus strobus, when pollinated by either P. monticola or P. griffithii, gave significantly higher cone and total seed sets than when pollinated by P. strobus; the reverse has been true in other years. These were excellent years for producing good seed in several white pines. In percentages of cones matured and total number of seeds per cone, 1949-50 was not greatly different from other years;

but a much greater percentage of the seeds were filled this year than ever before. This is shown in the following tabulation.

	1947-48	1948-49	1949-50
P. strobus x strobus			
Cone set, percent	57	37	18
Total seeds per cone	5.9	4.4	4.6
Full seeds per cone	1.5	0.5	3.8
P. strobus x griffithii			
Cone set, percent	30	30	33
Total seeds per cone	0.7	1.9	11.2
Full seeds per cone	0.1	0.1	3.1

The superiority of 1949-50 did not extend to other species that require 2 years to mature their seeds. The seed crop of the black oaks was a complete failure and that of the hard pines just about average.

In table 5 are shown the hybrid combinations from which seed was produced in 1950. Only those crosses are listed for which the parentage is reasonably certain; many crosses that yielded only a few seeds that may have resulted from contamination are omitted, as well as the many complete failures, which are listed below:

Acer plantanoides x rubrum
" " x negundo and reciprocal
" saccharum x negundo and reciprocal
" negundo x rubrum

Betula papyrifera x maximowiczii and reciprocal
" maximowiczii x pubescens

Fraxinus excelsior x pennsylvanica and reciprocal
" americana x excelsior
" " x pennsylvanica and reciprocal
" " x velutina

Picea glauca x asperata
" " x abies
" " x likiangensis
" " x wilsonii

Pinus strobus x bungeana
" " x (mixture of various hard pine species)
" " x cembra
" parviflora x cembra
" " x strobus
" griffithii x flexilis
" resinosa x (mixture of various hard pine species)
" densiflora x massoniana
" sylvestris x densiflora
" " x taiwanensis
" nigra x massoniana
" " x resinosa
" thunbergii x slyvestris
" tabulaeformis x massoniana
" " x thunbergii
" virginiana x banksiana

Particularly gratifying was the good set of hybrid seeds in the white pines (nearly 1,000 full hybrid seeds altogether). The reciprocal of one of these crosses (P. strobus x monticola) has already been shown as extremely promising in California. If the present crosses produce equally vigorous hybrids, mass production in natural hybridization gardens becomes an excellent possibility.

Another cross that might be mass-produced is that between green ash and Arizona ash; the growth possibilities of this are unknown as yet.

Two maple hybrids, both of which had been made in 1949, were produced in fair quantity this year. First-year measurements of the 1949 seedlings show that these hybrids, Acer platanoides x cappadocicum and A. negundo x henryi outgrew open-pollinated seedlings from the same female parents. These hybrids may be of value for timber and windbreak plantings respectively.

This season's crossing data, added to information from other years and other workers, gives valuable hints as to species crossabilities. Crosses between maple species in the same taxonomic section of the genus give 10 to 20 percent of the highest attainable seed set, whereas for crosses between species in different taxonomic sections yield only 0 to 5 percent, with many of the seeds poorly developed. In ash the only cross so far obtained is between two closely related species; less closely related species even in the same section have failed to cross. In pine virtually all crosses

between species on the same taxonomic series give a high set of empty seed but only crosses between very similar species give appreciable numbers of full seeds. In these genera closeness of taxonomic relationship is a clue to species crossability, which should not be overlooked in planning breeding work.

Seedlings obtained from intraspecific crosses in box elder provide data on the possibilities of selective breeding for vigor within species. The same parents were used in 1948 and 1949 (also 1950). In the fall of 1950 there were significant differences of up to 50 percent in the height growth of the progenies of different combinations of parents; the rank of the progenies was the same in all three years.

Interracial hybrids, made in red maple in large quantity in 1948, indicate good possibilities for racial hybridization. Height measurements showed significant differences between the progrnies of parents of different provenance. The relative height growth of Philadelphia x New Jersey, Philadelphia x Philadelphia, and Philadelphia x Massachusetts progenies was 100, 91, and 87 respectively.

By accident, the pollinating bags were left on several branches until fruit maturity. On two pine branches covered with weathered sausage casings the resultant seed yields were many times higher than had ever been obtained.

Chromosome counts were made during the year on various species of ash. Fraxinus ornus, F. anomala, F. velutina, F. spaethiana, F. longifolia, and F. bungeana were found to be diploid (2n = 46 chromosomes); F. pubinervis was tetraploid; and F. tomentosa hexaploid. Confirming previous work, both diploids and tetraploids were found in the white ash. The study of chromosome numbers, particularly in white ash, is being continued because of the probable effects of polyploidy on growth rate, wood quality, and crossability. Counts were also made on Acer buergerianum, A. cappadocicum, A. henryi, A. macrophyllum, and A. mayrii, all of which were diploid with 2n = 26 chromosomes.

Table 5.--Summary of successful crosses made during 1950 and 1949-50 breeding seasons

Parentage (female x male)	Seed set	Hybridity certain	Cross made before: place[1]		Remarks
	Percent				
Acer platanoides x mayrii	10.9	Yes	Yes	NE	
" " x cappadocicum	5.4	Yes	Yes	NE	Previous hybrids vigorous growers.
" " x saccharum	4.2	Yes	Yes	NE	Most seeds small.
" saccharum x platanoides	4.3	No	No	--	
" " x nigrum	6.6	Yes	--	--	Wild hybrids plentiful.
" negundo x platanoides	2.3	No	Yes	Russia	Russian hybrids vigorous.
" " x saccharum	2.0	No	No	--	
" " x henryi	9.0	Yes	Yes	NE	Previous hybrids vigorous.
Betula pubescens x papyrifera	.4	No	Yes	Sweden	Swedish hybrids vigorous.
" " x maximowiczii	.8	No	No	--	
" papyrifera x pubescens	.1	No	Yes	Sweden	
Fraxinus pennsylvanica x velutina	High	Yes	Yes	NE	
" velutina x pennsylvanica	Low	Yes	Yes	NE	
	Seeds per cone				
Picea abies x asperata	12.2	Yes	Yes	NE	
Pinus strobus x koraiensis	.8	Yes	Yes	NE	
" " x parviflora	3.4	Yes	Yes	NE,AA	Previous hybrids dwarfted.
" " x griffithii	3.1	Yes	Yes	NE,AA,CA	Previous hybrids vigorous.
" " x monticola	4.8	Yes	Yes	CA	Reciprocal hybrids in California most promising.
" griffithii x strobus	9.3	Yes	Yes		Previous hybrids vigorous.
" densiflora x sylvestris	.1	Yes	Yes	NE	Previous hybrids vigorous.
" " x thunbergii	1.3	Yes	Yes	Japan	
" " x taiwanensis	2.4	Yes	No	--	
" nigra x thunbergii	1.3	Yes	Yes	NE	Previous hybrids vigorous.
" " x sinensis	6.0	Yes	No	--	
" thunbergii x nigra	2.4	Yes	Yes	NE	Previous hybrids vigorous.
" virginiana x banksiana	.1	No	No	--	

[1] NE = Northeastern Forest Experiment Station. AA = Arnold Arboretum. CA = California Forest Experiment Station.

SUMMARY OF FOREST GENETICS WORK DURING 1950

Breeding

1. Propagated seedlings of hybrid origin (interracial and interspecific) in maple, ash, yellow-poplar, and pine derived from the 1949 breeding work.

2. Produced species hybrids in maple, ash, birch, spruce, and pine; a number of the hybrids were produced in moderate quantity.

3. Produced interracial hybrids in species of maple and yellow-poplar.

4. Made new chromosome counts in ash and maple.

5. Made observations on plantations of pedigreed progenies at the various experimental forests.

Field Tests

1. Prepared plans and instructions for long-term hybrid poplar tests to be carried out by personnel at the Station's various experimental forests.

2. Established additional stool plantings at the Beltsville Experimental Forest for production of cuttings for hybrid poplar tests.

3. Established uniform crop-tree and sapling clonal tests of poplar hybrids at Beltsville and Hopkins, and a sapling test at the Massabesic Experimental Forest.

4. Established field experiments to test the effect of 16 different cover crops on the growth of hybrid poplar cuttings.

5. Propagated hybrid pine seed received from the California Station for cooperative field tests in the Northeast.

6. Continued cooperation with Division of Forest Pathology on diseases of hybrid poplar.

Physiology

1. Demonstrated differences in seed set according to the length of time the bags were left on flowering branches and the

year in which the work was done. Conditions favoring good fruit set were not necessarily the same as those favoring good, viable, seed set.

Racial Variation

1. Propagated seed of white and green ash of various geographic origins.

2. Propagated seed of many desirable exotics from seed of known origin.

3. Demonstrated differences in 2-year height growth in red maple and box elder progenies.

PLANS FOR FOREST GENETICS WORK IN 1951

1. Establish additional hybrid poplar sapling and crop-tree clonal tests at the Beltsville and Hopkins Experimental Forest, and the first sapling tests at the Delaware-Lehigh and Fernow Experimental Forests.

2. Establish the first pilot plantations with select poplar hybrids at the Beltsville and Hopkins Experimental Forest.

3. Continue the cover crop-hybrid poplar studies started in 1950.

4. Start exploratory soil studies to provide criteria for the classification of soils as to suitability for the growth of hybrid poplar.

5. Continue cooperation with the Division of Forest Pathology on diseases of hybrid poplar.

6. Establish seedlings of maple, ash, and yellow-poplar, derived from controlled breeding, in field plantations.

7. Continue exploratory hybridization work at Morris Arboretum with maple, ash, birch, spruce, fir, and pine, using specimen trees in the Philadelphia area which bloom in 1951.

8. Special study of crosses which may be made in quantity, particularly those between desirable parents.

9. Continue racial hybridizations in ash, maple, and yellow-poplar.

10. Cross the best of the new hybrid poplars with selected native cottonwoods (on cut branches in the greenhouse) to increase disease resistance.

11. Study the effects of continuous bagging and other bagging variations on seed production.

12. Propagate seed derived from 1950 controlled breeding in the greenhouse and nursery at the Morris Arboretum.

WATERSHED MANAGEMENT

(forest influences)

WATER CONTINUES to command great attention throughout most of the Northeast. Although the acute condition of the New York City water supply has been somewhat alleviated by adequate precipitation during the past year, the situation will continue to be critical until additional supplies are made available. In addition, some of the New England area has become increasingly aware of problems arising from poor distribution of water yields during the year.

Due to the fact that surface water constitutes the major source of supplies for domestic and industrial uses, it is necessary that large impounding reservoirs be constructed to insure that supplies will be available at the time needed. These structures require large expenditures of money and should be protected from loss in capacity due to excessive siltation.

During the past year the Station, in cooperation with the Soil Conservation Service and New York City, made a survey of Schoharie Reservoir to determine the amount of siltation that has occurred during the past 24 years. This reservoir, part of the New York City water system, is located on Schoharie Creek, a tributary to the Mohawk River. Concurrently with the reservoir survey, a reconnaissance survey of the watershed was made to determine land uses and conditions that might be causing accelerated erosion.

During the 24-year period since completion of the dam, some 1,119 acre-feet of sediment have been deposited in Schoharie Reservoir. In addition, an estimated 240 acre-feet have passed through the reservoir in suspension and have been carried out by the effluent through the diversion aqueduct. Although the total 1,369 acre-feet does not constitute an excessively large volume for the 24-year period, deposits in the upper end of the reservoir are beginning to interfere with diversion of water from the reservoir. Considerable deposition

has occurred in the reservoir near the intake to the diversion aqueduct. This has resulted in a raising of the elevation to which the reservoir can be drained by the intake works. The usable storage is thus decreased considerably more than is indicated by the volume of siltation.

The reconnaissance survey of land conditions in the watershed was made largely by stereoscopic study of aerial photographs, but this was supplemented by field examination of roads, stream channels, and logging operations.

It was found that about 55 percent of the 314 square-mile watershed is covered with forest, and about 43.5 percent is in grass. Slightly more than 1 percent is plowed in any one year and a few small villages occupy the remaining area.

Steep slopes predominate on the watershed; more than 60 percent of the area is on slopes steeper than 20 percent. About two-thirds of the steep land is forested, the remainder being largely grassland.

Although nearly 80 percent of the forested area is classified as "steep", 84 percent of this area shows "little" or normal erosion, while 15 percent shows moderate erosion. Less than 1 percent had severe erosion. This is striking when compared with the grasslands. Less than 40 percent of the grass areas occur in the steep category and yet more than 85 percent of these lands show moderate to severe erosion. Examination of the grasslands shows that heavy grazing has reduced the grass cover on many of the pastures.

Examination of roads and stream channels showed little eroded material was being derived from these sources.

Logging operations examined showed that the method of skidding had a great influence upon the amount of erosion that might result. Skid trails running down the slope are the main source of eroding material from the forested lands. Where skidding was done by tractor, erosion was generally much more aggravated than where horses were used.

The significance of these findings may be summarized as follows:

- Overgrazing of the grasslands has resulted in accelerated erosion from these areas. These areas are now contributing most of the eroded material being carried by the streams. Under present practices this condition will certainly

continue and probably will increase as more of the protecting turf is removed.

- Tractor skidding of logs down the slopes has created some erosion "sore spots". These conditions, once started, will continue for a long time unless corrective measures are taken. Steps should be taken to prevent practices of this nature in the future.

- The fact that accelerated erosion is occurring on much of the grasslands indicates that surface runoff is frequently taking place on these areas. This points to high streamflow during storm periods, with water thus lost not being available to maintain flow during dry periods.

The findings of the surveys in Schoharie Watershed furnish a guide to probable conditions in the headwaters of the Delaware River. The City of New York is at present constructing a large dam in the East Branch of the Delaware for the purpose of storing and diverting water. Another large dam and reservoir is proposed in the West Branch of the Delaware. This latter reservoir will be used to reduce flows during high water periods and provide water to maintain higher flow during dry portions of the year.

The watershed of the East Branch is approximately 60 percent forested while the West Branch contains about 45 percent of forest land. The remaining area in each watershed is largely pasture with a small portion devoted to crops. Geologic formations and soil types found in Schoharie watershed are also found in the Delaware areas. A large part of the pastured area is steeply sloping and considerable evidence of over-grazing is present.

From the observations in Schoharie it is reasonable to assume that:

- Accelerated erosion is occurring from steep, overgrazed pastures in the headwaters of the Delaware. Highly valuable storage space in the new reservoirs will be occupied by deposition of this eroded material.

- Surface runoff from these same pastures is contributing in a large measure towards the undesirable conditions of streamflow--frequent high flows during storm periods and very low flows during other portions of the year.

REVEGETATION OF STRIP MINE AREAS

Mining bituminous coal by removing the overburden and excavating the coal with drag-lines and bulldozers has resulted in the accumulation of considerable areas of unstable detritus in Western Pennsylvania, Ohio, and West Virginia. These areas constitute erosion "sore spots" that contribute large volumes of material which are deposited in important water courses. Considerable effort and study has been carried out in Pennsylvania and Ohio to determine the best method of revegetating these waste areas.

Little work of this nature has been done in West Virginia, but the demand for information on how to revegetate spoil banks has increased as the stripped area has increased. To supply this need for information a survey of stripped areas in West Virginia was made by the Station. This survey furnished a basis for comparing conditions of stripped areas in West Virginia with those where more comprehensive studies have been made. The pertinent findings from this survey and the resulting recommendations are:

- Ninety-five percent of the spoil banks in West Virginia can be successfully planted to trees within a year or two after stripping. Spoils with a pH below 4.0 do not revegetate well either naturally or artificially. Such areas constitute the unplantable 5 percent of the total spoils area. Evidence indicates that within 10 years the acidity in practically all of these areas will be reduced to a point where revegetation is practicable. Aside from acidity, there are no critical natural factors preventing tree revegetation.

- Natural revegetation to trees is considerably delayed. The droughty conditions found on spoil banks may account for this. Bare spoil surfaces become hot and dry; the roots of most young seedlings do not penetrate deep enough to obtain sufficient water supply. Apparently many seedlings germinate but most of them succumb when the weather gets hot and dry. Planted trees, with their already-developed root systems, fare much better.

- Early spring planting is recommended to reduce frost heaving and winter killing.

- Ungraded or partially graded spoils appear to offer better planting sites than completely graded areas. It is believed

that the compaction resulting from leveling with heavy equipment decreases both survival and growth of young trees.

- The following species are recommended for spoil-bank planting in West Virginia where the pH is 4.0 or higher: Conifers--Red pine, pitch pine, jack pine, Virginia pine. Hardwoods--Black locust, yellow-poplar, red maple, sycamore. Red pine should not be planted at elevations below about 1,500 feet. Virginia pine may not be suitable for planting above about 2,500 feet. Black locust is an excellent species for erosion control and site rehabilitation.

In addition to the recommended species, numerous others are adapted to many of the spoils, but more experience and research are needed before the conditions under which they would be successful in West Virginia are understood.

The principal aims of these recommendations are to produce a tree cover which will reduce or prevent surface runoff, erosion, stream pollution from silt, and reservoir sedimentation; heal the scars on the land; and build up the site so that the land will become productive once again.

RAINFALL INTERCEPTION

Interception of rainfall by vegetation has received considerable study throughout the years both in Europe and this country. In 1919 Horton presented a treatise on the subject in which he gave a digest of past findings, analyzed the processes involved in interception, and gave the results of a number of measurements made by himself in New York State. Since that time a number of other workers have measured interception under a wide range of climatic and vegetative conditions. One of the most recent publications on the subject is "Rainfall Interception by Chaparral in California" by Hamilton and Rowe of the California Forest and Range Experiment Station.

During the past year rainfall interception measurements were started on the Delaware-Lehigh Experimental Forest, Monroe County, Pennsylvania. These measurements were undertaken to evaluate one of the hydrologic factors needed to establish the water economy for a watershed covered largely by scrub oak. Most of the work done by other investigators has pertained to interception by tree species. Although scrub oak resembles the chaparral where Hamilton and Rowe made their studies, it

was thought desirable to take some measurements in scrub oak to be sure the relationships determined for chaparral held true in the scrub oak areas.

Measurements made during the period June through September, 1950, show that interception by scrub oak corresponds closely with interception by chaparral. The relation between net interception and size of storm in the scrub oak may be expressed by the equation:

$$IL = .032P + .025$$

in which IL is interception loss, and P is storm precipitation. This compares quite closely with:

$$IL = .027P + .031$$

which is the relationship found by Hamilton and Rowe for partially deciduous chaparral during the fall and winter. They found that during the spring and summer, the same area showed a relationship of:

$$IL = .070P + .050$$

The difference between the relations for scrub oak and those for chaparral area during the spring and summer is due to the fact that the scrub oak forms a much less dense canopy than the chaparral and, in the areas studied, is considerably shorter.

SUMMARY OF JOBS DURING 1950

Water Relations

Streamflow

To determine the influence of changes in vegetation upon streamflow-precipitation relations in the Delaware River basin, the Station during 1950—

1. Continued the collection, tabulation, and compilation of streamflow and precipitation data for the Dilldown watershed of the Delaware-Lehigh Experimental Forest.

2. Continued the collection, tabulation, and compilation of streamflow and precipitation data on the Pocono Experimental Forest.

3. Established rainfall interception measuring equipment on the Dilldown watershed and the Pocono Forest.

4. Established a climatic station on the Pocono Experimental Forest.

5. Started preparation of a problem analysis of the Delaware basin. In preparation for this, completed cooperative survey of siltation in Schoharie Reservoir and survey of watershed to determine sources of sediment and conditions causing erosion.

6. Prepared a manuscript describing the Delaware-Lehigh Experimental Forest, research now under way, and presenting data and results to date.

7. Completed topographic survey around boundary of Dilldown watershed and computed area to be 2.39 square miles.

To determine the influence of forest management practice and logging operations upon streamflow-precipitation relations in West Virginia, the Station—

1. Completed installations for measurement of streamflow on five small watersheds on the Fernow Experimental Forest.

2. Completed the first draft of a work plan for watershed studies on the Fernow Experimental Forest.

3. Prepared geologic, soils, and cover maps of the Fernow Experimental Forest.

4. Started installation of precipitation gages on the Fernow Experimental Forest.

5. Started preparation of a problem analysis of the West Virginia problem area.

Quality

To determine the effect of forest management, changes in vegetation, logging and other access roads, and skid roads upon quality of water, the Station—

1. Established permanent reference points for measurement of soil losses from skid roads on the Fernow Experimental Forest.

2. Continued periodic measurement of water-quality factors on the Dilldown and Pocono areas.

Soil Relations

Ground Water

To determine the effect of changes in vegetation upon amount and movement of ground water and the relation of ground water to streamflow, the Station—

1. Continue collection, tabulation, and compilation of ground-water elevations on the Dilldown watershed.
2. Prepared a groundwater-depletion curve and storage curve for the Dilldown watershed.
3. Dug three additional shallow wells on the Dilldown watershed and equipped them with water-level recorders.

Storage

In a study of the relationship of cover and soil to the amount of water stored in the soil—

1. Continued periodic observations of soil moisture at each of the permanent sites in the Dilldown watersheds.
2. Adjusted calibration curves, developed in the laboratory for each of the electrical soil units, by moisture determinations after units were installed in the Dilldown watershed.
3. Computed soil moisture changes in the Dilldown watershed during selected storm periods to check methods of computation.
4. Prepared an alinement chart to facilitate computations of resistances in using the electrical soil moisture meter.
5. Prepared a manuscript describing the alinement chart and its use.
6. Prepared a manuscript describing a new method of classifying soil depth.

Infiltration

In a study of the relationship of cover, soil, and other factors to the incident, type and depth of frost—

1. Continued regular observations of soil freezing on the Dilldown watershed.

2. Established a series of plots on different land uses and conditions in Maine, New Hampshire, New York, Massachusetts, and Pennsylvania. Started periodic observations of frost type and depth, and depth of snow mantle on all these plots.

3. Provided advice in the establishment of laboratory studies of soil freezing at Pennsylvania State College.

4. Presented a paper at the Eastern Snow Conference, pointing out the factors to be considered in analyzing the soil freezing problem and what additional research is needed.

General

The Station provided information and assisted in the preparation of reports upon forest land and water resources relationships, problems and programs for the Potomac, Delaware, Ohio, and Connecticut drainage basins. These were intended to furnish information for the use of the President's Water Resources Policy Commission.

PLANS FOR 1951

The following plans for forest influences research activities are presented by individual research centers.

Adirondack Research Center

Continue observations of soil freezing and snow depths in the vicinity of Paul Smith Experimental Forest until end of spring thaw.

Anthracite Research Center

Complete installations and continue collection of records on the Pocono Experimental Forest watershed.

Continue observation of soil freezing and snow depths in the vicinity of the Pocono Experimental Forest until the end of the spring thaw.

Delaware Basin Research Center

Continue collection, tabulation, and compilation of data from the Delaware-Lehigh Experimental Forest.

Analyze first 2 years' data and evaluate all factors needed to establish a water balance for the Dilldown watershed.

Complete vegetative survey of Dilldown watershed.

Complete topographic survey of Dilldown watershed.

Continue participation in scrub oak conversion studies on the Delaware-Lehigh Experimental Forest as described in the section on Forest Management.

Complete the problem analysis for the Delaware River basin.

Continue observations of soil freezing and snow depths in the West Branch of the Delaware.

Mountain State Research Center

Continue measurements of erosion from logging skid roads on the Fernow Experimental Forest.

Continue establishment of installations on the five small watersheds in the Fernow and start collection of data as installations are completed.

Complete the problem analysis for the Mountain State problem area, including such river basin areas as Monongahela, Potomac, Kanawha, etc.

Northern Hardwoods Research Center

Continue observations of soil freezing and snow depth in the vicinity of the Bartlett and Hopkins Experimental Forests.

Prepare an analysis of watershed problems for the White Mountain area of New Hampshire.

Penobscot Research Center

Continue observations of soil freezing and snow depth in the vicinity of the Penobscot Experimental Forest.

Station Headquarters, Upper Darby

Analyze frost and snow data collected during the 1950-51 winter at the various centers and prepare a report of results.

THE FLOOD CONTROL SURVEYS

THE ONLY MAJOR STORM in 1950 that caused serious widespread floods in the Northeast was that of November 25. Heavy snows fell west of the Allegheny Mountains in West Virginia and western Pennsylvania, while torrential rains occurred east of the mountains. Flood damages were heavy in some watersheds. This storm was accompanied by high winds reaching or exceeding hurricane force of 75 miles per hour at many points. Blow-down of timber was serious in several areas in New York and New England. The added fire hazards created are a matter of particular concern since fires are among the leading causes of deterioration in watershed conditions.

While basin-wide floods make national headlines, local flash floods often do not. However, because of their more frequent occurrence, the latter cause more aggregate flood damages than the widespread occasional flood. The Northeast experienced its usual quota of such local floods spread throughout its entire territory. Many of these flash floods exceeded all previously recorded flows. They were particularly severe in New York, Virginia, West Virginia, Pennsylvania, Vermont, and Maryland.

The indications are that watershed conditions in the Northeast are continuing to deteriorate and flood losses will increase. Thunderstorms of cloudburst proportions caused flash floods in north-central West Virginia during the night of June 24-25. Damages were estimated in excess of $10,000,000. By the time the waters receded, 31 people had lost their lives, 123 homes had been destroyed, and 1,292 other homes damaged. Heavy damage had been done also to growing crops and farm lands. Bridges and roads were swept away. Railroad rights of way and freight were damaged. Various industrial plants, public utilities and many smaller business enterprises suffered loss.

STATUS OF SURVEYS, END OF 1950

Surveys by the Forest Service, Soil Conservation Service cooperating, on the following watersheds:

Connecticut.--Report completed and forwarded to Washington.
Merrimack.--Analysis nearly completed and report in preparation.
Allegheny.--Field work completed except for additional investigation on supplemental structures. Most of the analyses completed.
Upper Susquehanna.--Field work completed. Analysis started.
Monongahela.--Land-use field survey completed.
Salt.--Field survey well under way.

Surveys by the Soil Conservation Service, Forest Service cooperating, on the following watersheds:

Delaware.--Report completed and forwarded to Washington.
Youghiogheny.--Report in preparation.
Roanoke.--Report in preparation.
Lower Susquehanna.--Field survey completed and analysis started.

Preliminary-examination reports were prepared and submitted to Washington on the Salt, Raritan, and Lower Susquehanna watersheds. A preliminary-examination report was also submitted covering all streams in the States of North Carolina and Virginia flowing into Albemarle and Currituck Sounds between the Chowan River and the James River.

SOME RESULTS OF STUDIES CONNECTED WITH THE FLOOD SURVEYS

Analysis of soil-moisture data, collected on the Allegheny and Susquehanna watersheds, has been completed. The purpose of the analysis was to determine the rates of water movement and the storage capacities of the soil profiles for the principal soil-cover complexes and how they are affected by land use and management. Quantitative values of percolation and transmission rates and detention and retention storage capacities were established for the soil horizons of the principal soil-cover complexes. The percolation rate and detention storage values vary significantly with the type and density of vegetative cover. For open land, percolation rate and detention storage were lowest for row crop areas and highest for close grown crops. Where forest land was grazed or burned, soils had significantly lower values than ungrazed or unburned areas.

Land use and management affects the water values of the upper soil horizons the most, the lower ones the least. The results of the study are being published as a Station Paper entitled "Effect of Soil and Cover Conditions on Soil-Water Relationships."

From an analysis of data on humus collected on the Allegheny watershed, it was found that depth of humus increases with stand age until maximum foliage production is reached, and is correlated with stand density. Density of stand generally controls the balance between organic accumulation and decomposition. Grazing, fires, and logging have destructive effects on humus layers, depending on their intensity and frequency or duration. The results of this study were published in an article "Some Factors Affecting Humus Development in the Northeast," in Jour. Forestry 48: 341-344.

The results of the soil-moisture and humus development measurements were combined with the land-use inventory of the Allegheny watershed in order to develop a method for evaluating hydrologically the effect of land use and management on flood runoff. The surface runoff is determined for each soil-cover complex by routing the available rainfall supply through the soil profile for successive periods of uniform rainfall intensity.

The amount of water infiltrated into the soil profile for any time interval depends on the amount of storage available and its rate of availability. Drainage of the upper soil horizons during periods of light or no rainfall makes storage again available in these horizons when excessive rainfall occurs later. The results of this analysis will be submitted for publication to the American Geophysical Union in an article "Determination of Surface Runoff by Routing Infiltrated Water Through the Soil Profile."

PLANS FOR 1951

During the first half of the year it is expected that reports on the Merrimack, Salt, Roanoke, and Youghiogheny watersheds will be completed and forwarded to Washington. A large part of the Flood Control Survey work during 1951 will consist of surveys in the New York-New England area. Surveys of watershed conditions and of remedial measures needed in this area will be an important part of the Inter-agency comprehensive survey discussed in the section "Some over-all matters."

THE FOREST SURVEY

STATUS OF FIELD INVENTORY WORK

FOREST SURVEY field inventory work completed in 1950 increased the covered forest land area from 29.4 million acres to 36.3 million (fig. 1). New Hampshire, Vermont, and West Virginia had been covered prior to 1950, but as the timber-volume data were being compiled it became apparent that additional information on saw-timber quality would be highly desirable. Therefore, field crews were sent back into Vermont and West Virginia to procure such data.2/ The job has been finished in Vermont and is nearly finished in West Virginia. In the other states the saw-timber quality data is being collected as part of the inventory.

The percentage of forest area covered in those states where field work is now in progress is as follows: New York , 72 percent; Pennsylvania, 32 percent; Maryland 83 percent. The single county that has been covered in Maine was done in a special survey several years ago.

The backlog of forest-type mapping allowed to accumulate last year was completed during the winter months. Except for a portion of New York, type-mapping has been kept abreast of the field inventory during 1950. The office job of compiling state maps from the individual field maps has been completed for New Hampshire and Vermont. Work is now under way on the West Virginia forest-type map.

A survey was made in Maryland to determine the amount of forest products produced in the state. These data will be used in estimating drain from the forests. A plan for a survey

---

2/The New Hampshire job was too far advanced to justify going back at this time.

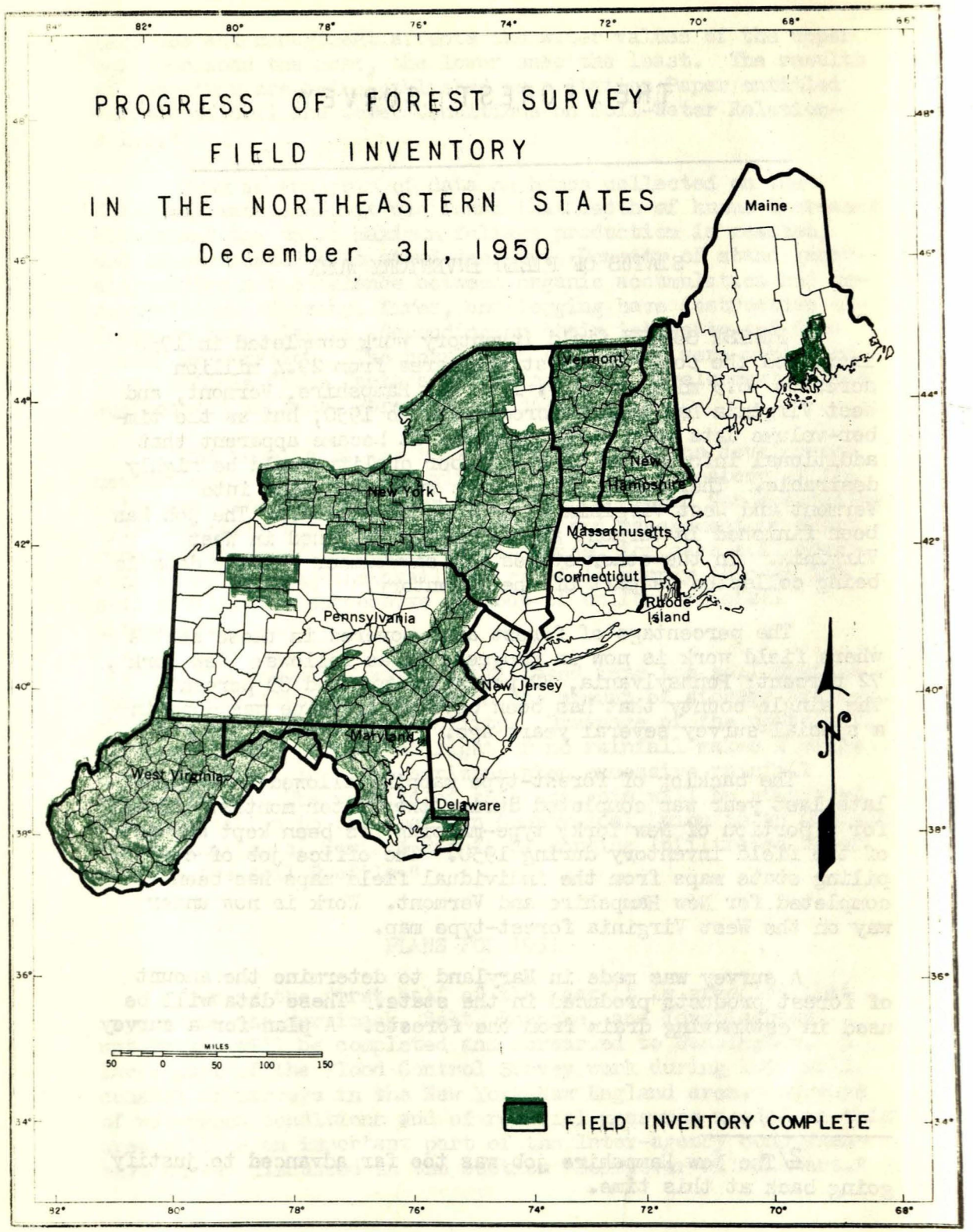

PROGRESS OF FOREST SURVEY
FIELD INVENTORY
IN THE NORTHEASTERN STATES
December 31, 1950
Maine
Vermont
New Hampshire
New York
Massachusetts
Connecticut
Rhode Island
Pennsylvania
New Jersey
Maryland
West Virginia
Delaware
MILES
50 0 50 100 150
FIELD INVENTORY COMPLETE

FIGURE 1

of commodity drain from the forests of New York was prepared and submitted to the Bureau of the Budget for approval.

REPORTS AND SPECIAL STUDIES

The statistical compilation for New Hampshire is completed and the state statistical report is being processed for publication. The compilation job for Vermont and West Virginia is nearing completion. Forest-area and timber-volume data have been compiled for one unit of counties in western Maryland and for two units in New York.

The review draft of the interpretive report for New Hampshire is also nearing completion. Work on similar reports for Vermont and West Virginia is under way.

Last year's annual report (page 38) discussed some of the problems in measurement of growth, mortality, and commodity drain. Having no previously measured survey plots that could be re-examined, the growth, mortality, and commodity drain estimates, in any initial forest survey, must be derived by indirect methods--increment borings as an index of growth, general appearance of dead trees as an indication of when they died, volume of primary forest products processed as an indication of commodity drain. Estimates based on these methods could be greatly strengthened by a periodic re-measurement of an adequate sample of survey field plots. It may even be possible to obtain reliable estimates of growth, mortality, and drain entirely by plot-remeasurement methods. With this possibility in mind, the Forest Survey has been carrying on a special study in Maryland. It consists of four parts:

1. Determination of the relative efficiency of plot versus individual tree data in estimating growth.

2. Determination of the cost of establishing supplemental plots for estimating drain.

3. Experimental use of aerial photographs for estimating commodity drain when duplicate photo coverage of different dates is available.

4. Test of the use of cubic-foot volume classes in photo interpretation to stratify forest area.

Three of the counties included in this special study have been completed. Also, in connection with part 1 above,

individual trees were remeasured on 35 permanent plots. These plots were established by the Dead River Company on their lands in Maine about 10 years ago. These remeasurements were made possible through the assistance of a forester from the company.

PLANS FOR 1951

At present the full impact that special defense projects will have on the progress of the Forest Survey is not known. Undoubtedly there will be slowing down in some areas and possibly a speeding up in others. Barring a decided upset in plans, progress in 1951 should be about as follows:

Inventory

Field work will continue in New York, Pennsylvania, and Maryland. By the end of the year about 94 percent of the forest land of New York, 46 percent of Pennsylvania, and 100 percent of Maryland should be covered. This makes a total of about 6 million acres of forest land to be inventoried in 1951.

Growth And Drain

Drain and woods-waste studies are planned for New York during 1951.

Reports

State statistical reports for Vermont and West Virginia are planned for completion during 1951. In addition, review drafts of the analytical reports for these two states should also be completed. The analytical report for New Hampshire will go through the review process and be submitted for publication. There is a substantial possibility that the New Hampshire forest-type map will be published by one of the state agencies.

THE FOREST RESOURCE
and related economic studies

IN ADDITION TO analyses of forest survey data and their use in various forest survey and other economics reports, research in forest economics during 1950 involved three main projects: (1) Prices and marketing of farm forest products; (2) area studies; and (3) economics of forest management.

PRICES AND MARKETS OF FARM WOODLAND PRODUCTS

A statewide survey of all buyers of forest products in the State of Rhode Island was carried to completion. In this project the Station collaborated with the State's Extension Forester. The results of the survey were published as a bulletin of the Extension Service of Rhode Island State College. Another survey of similar character for the Monocacy River watershed of Maryland and Pennsylvania was also completed. This one was made at the request of and in cooperation with the Maryland Department of State Forests and Parks. A report is in proccess of publication by the Station.

The other major emphasis in the marketing-research project was on quality specifications. This took the form of a series of hardwood log-grading test-demonstrations that were completed at four mills--one in western Pennsylvania, one in West Virginia, and two in Maine. In all instances, the results were gratifying. Operators were able to observe the grading procedure, and to see the significant separation of raw material values that can be obtained by log grading. Results of these tests have been summarized in a Station Paper, now in process of publication.

AREA STUDIES

Two special area studies were completed in 1950. The first of these included the 7-county area surrounding Cumberland, Maryland. Chronic unemployment has here been a problem for some years. A locally organized committee appealed to the Federal Government requesting a survey of the area to analyze its resources and determine the possibilities for any expansion of economic activity and employment. The study was organized by a joint committee of the Departments of Commerce and Labor. The Station was requested to prepare a report on the forest resources and forest-based employment in the area. This report was submitted to the joint committee for use in its over-all study.

The other area study covered the Monocacy River watershed of Maryland and Pennsylvania. A locally-organized Monocacy River Watershed Council has set out to develop a program that will regulate the flow of the river and its tributaries, reduce the siltation of the streams, control land erosion, and generally rebuild the renewable natural resources of the area. The Maryland Department of State Forests and Parks, cooperating with the Council in its commendable effort, asked the Station to prepare a report on the forest lands of the watershed and to give special attention to the kind of forest program that would preserve and improve forest watershed lands. The report has been finished and is in process of publication as a Station Paper.

ECONOMICS OF FOREST MANAGEMENT

Experimentation in the biological aspects of forest management has been in progress in various places in the Northeast for many years. A considerable body of technical information has been accumulated. There has, however, been a serious lag in the application of this biological knowledge to the management of the region's forest resource. One explanation of this failure on the part of forest owners to apply the management practices that have been recommended by foresters is that most of the owners are not yet convinced that the practices are financially feasible.

The compartment studies now under way on the experimental forests of the Station are designed for the dual purpose of testing various systems and intensities of silviculture from the standpoint of physical production (both quantity and quality) and also from the standpoint of economic cost and

return. A record-keeping system that will provide these kinds of information has been established and put into use. It will, however, be some time before results will begin to become available.

Meanwhile, a considerable body of useful knowledge can be obtained by case studies of a limited number of small forest areas that have been under management for some period of time. The prerequisite in selection of areas to be studied is that forest management has been in practice and there is a system of records with sufficient accuracy and detail to justify careful analysis.

Three aspects of forest-management experience on these areas can profitably be studied. The first has to do with the physical efficiency in carrying out the various operations that are involved in the management of a forest property. There is a scarcity of reliable data on the amount of labor, equipment, materials, and supervision required to carry on operations such as planting, cleaning and weeding, pruning, thinning, removal of unmerchantable cull trees, harvest cuttings on the tree-selection, shelterwood, or patch-cutting basis, maintenance of permanent roads, and technical operations such as markings, stand inspections, and management cruises.

The second aspect of experience that merits study is the physical effects that have been obtained through the application of one or a combination of silvicultural treatments. Areas where studies of this kind can be done are limited to those that have been under management for some time.

The third aspect worthy of attention is the question of whether the enterprise under study shows evidence of overall financial gain or loss from the forest-management venture.

Working plans for a series of case studies of this type were being developed in the latter months of 1950. Field work is being scheduled to begin soon

PLANS FOR 1951

The plans for work in 1951 assume that it will be necessary to give considerable time and effort to special defense work such as the logging-equipment-requirements survey, the current study of veneer-industry capacity and raw-material sources, and related work. With such a prospect, plans must be somewhat tentative.

Prices And Marketing Of Farm Forest Products

Within this field, three specific jobs are contemplated. The first involves a study of the poles and piling market as an outlet for farm timber. The second involves an extension of log-grading test-demonstrations to mills in Vermont and New York. The third involves collaboration with the State Foresters and Extension Foresters of New England in a region-wide survey of forest products markets and prices. Under present conditions the last-named study has the lowest priority.

Role Of Forests In The Economy Of New England And New York

The opening section of this Annual Report gives background on the comprehensive resource survey that is being initiated in the New England-New York area. Fulfillment of the Station's responsibilities in that survey will require a considerable amount of economic analysis. Specific studies already planned and under way include: (1) Net receipts and net shipments of forest products by rail and waterborne carriers, New England and New York, 1948; (2) the electric-power requirements of wood-processing industries of New England and New York; (3) employment and payrolls of the timber-based industries of New England and New York. Further studies of this general character will be developed.

Economics Of Forest Management

The case-history studies on the economics of forest management, as described above, will be carried to somewhere near completion in 1951.

THE FOREST UTILIZATION SERVICE

LOG GRADES AND TIMBER QUALITY

IN TACKLING THE PROBLEM of log grades, three studies were made to explore the problems of and progress toward an adequate system for uniformly and objectively measuring hardwood timber quality. One report, dealing with the advantages of recognizing quality in timber, was presented at the University of Maine's "Farm and Home Week." A second, dealing with research needs, was presented at a sectional meeting of the Forest Products Research Society. A third, covering the subject in a general manner, was prepared for the national annual meeting of the same society. In addition, seminars with forestry students, faculty, and millmen were held at the New York State College of Forestry, Yale University, at meetings of the Forest Products Research Society, and at the Penn-York Lumberman's Club fall meeting.

A demonstration of the operation of a log-grading system was held in the Berkshires in cooperation with the Extension Forester and the Forestry Department of the University of Massachusetts. Four schools dealing with the subject were held for Forest Service technicians in New York State, Pennsylvania, West Virginia, and Virginia. A fifth school was held in Vermont for the staff of the Vermont Forest Service. As a result of this training effort, some aspects of the Forest Survey field work have been strengthened, timber sale appraisal on the National Forest has been improved, and a special survey of timber quality in the State of Vermont is being undertaken by the Vermont Forest Service.

The grading system as developed today applies to hardwood timber both in the tree and in logs. Widespread use of the system is believed essential to integrated utilization. As it now stands, however, the system lacks the quality factors for sub-log material. Consequently, in cooperation with Forest Products Laboratory technicians, a study was made of the expanding boltwood industry in the Northeast as a basis for problem analysis and planning for future research work in

this field. In cooperation with the Pack Demonstration Forest of the New York State College of Forestry, a special study of the very poor hardwood logs and bolt utilization was set up for early action next year.

The Station also conducted tests of the factory grades developed by the Forest Products Laboratory when used to measure quality of logs designed for specialty items such as handles and dowels. For handles the grades appear to perform adequately; for short maple dowels, segregation based on gross money yields was inadequate. Unquestionably studies of net yield would show the grades to meet the objectives.

LOGGING AND MILLING

Past work of the Station on logging equipment and methods culminated in the publication (in January 1951) of the Northeastern Loggers' Handbook, a 160-page illustrated publication which brings together for the first time practical information that will not only help to improve techniques of older loggers, but will also form the basis for training new ones. The preliminary edition of the handbook, processed in sections, was so popular that we have thousands of requests for the complete publication. A pony edition published a year ago as Farmer's Bulletin No. 2008, entitled "Logging Farm Forest Crops in the Northeast," ran through 30,000 copies in two months. The Soil Conservation Service, early in 1950, ordered an additional printing of 10,000.

During 1950, a section on land transport of forest products was prepared for the proposed Society of American Foresters' Field Manual. Help was given the Adirondack Lumberman's Club and the West Virginia Forest Council in arranging for field days in which latest equipment was demonstrated.

Not much new equipment appeared in 1950. Some items of note were a completely mobile sawmill and a power wood splitter developed in New York State; and a portable wood cut-up mill developed in Connecticut and now ready for manufacture by a New York State firm.

A study started in 1949 in connection with Connecticut agencies dealing with portable chippers, was completed and results were published as Station Paper No. 37, (A Pilot Study of a Portable Wood Chipper) and elsewhere. Aid was given the Vermont Bureau of Industrial Research in setting up a plan for additional wood-chipper studies. Station personnel participated

in a Northeastern Wood Utilization Council conference on the production and use of wood chips.

To improve the use of beech, the Northeastern Technical Committee on Beech, composed of representatives of 18 forestry agencies, is preparing a series of 23 papers in which will be presented best available information on this species. The Station is undertaking the editing and publishing of the series. To date, ten papers have been prepared but none published as yet. Work on most of the remaining thirteen is well advanced.

Marketing of planted red pine thinnings was the subject of another investigation. Connecticut operations, in which items such as highway posts, special fence rails, tobacco posts, flag poles, and the like were prepared for market were analyzed, and a paper on the results has been written.

Other investigations in cooperation with the New York State Conservation Commission and Connwood, Inc., went into the possibilities of roofing felt in New Jersey as a market for chips. Tests of the technical quality of red pine as compared with that of pitch pine, made by the Forest Products Laboratory in their new Asplund defibrator, showed red pine to be equal to pitch pine, but to have no outstanding superiority, for the purpose. Main obstacle for reaching this market appears to be uncertainty of marketing committments in dealing with state-owned timber and high freight rates on both wood and chips.

SEASONING

The use of kilns in the drying of eastern white pine has been held back because kiln-dried pine often develops a chemical brown stain. Much work has been done on this in the West, but little in the East. During the year, Prof. Gregory Baker of the University of Maine, using the experimental kiln lent by the Forest Products Laboratory, embarked on a study of this problem. By year-end favorable preliminary results were obtained. As in the West, the problem appears to hinge on storage. Lumber from logs cut, milled, and dried immediately showed no stain. Lumber from those with delayed conversion showed stain. A new series of tests is planned for next year to pin down the timing of logging operations, so as to minimize stain, or to modify kiln schedules for drying lumber, the processing of which has been delayed.

To improve kiln practice generally, a study was made of commercial dry-kiln schedules in this region. This study will serve to check new and generally faster schedules now being prepared by the Laboratory, as a result of its own research. The Laboratory completed its nation-wide study of mechanical handling of lumber in which the Station participated in 1949. This should lead to recommendations for best and cheapest practices. The Laboratory also completed a study of the suitability of crop driers for drying lumber. Forest Utilization Service personnel of the station started an investigation to determine prevalence of crop driers in the Northeast. Although there are large numbers of crop driers, few of these use heat. Further investigation will be required to determine the possibilities of the common type of drier in the lumber field. If they prove suitable, they will be a valuable addition to a kiln capacity already overstrained.

WOOD PRESERVATION

The Station continued to cooperate with Connecticut agencies in studies of simple methods of wood preservation, particularly that applicable to farm use. One was the cold-soaking method using pentachlorophenol; others were variations of the diffusion method.

On a local farm estate, 25-year-old red pine plantations were thinned in May to produce highway-guide-rail posts. The posts were hand-peeled and left in the plantations for drying. After 9 weeks, moisture content dropped from 150 percent to 20 percent. At that point the posts were soaked for about 36 hours in 5-percent solution of pentachlorophenol and No. 2 fuel oil. In this time, a retention of more than 7 pounds per cubic foot was secured, with a penetration of more than $1\frac{1}{2}$ inches. Cost of preservative was 30 cents a post. Twenty-four hundred treated posts were sold for local highway use. Smaller posts were prepared for stock fence use by treating unpeeled posts with zinc chloride by the barrel method. The farm manager found the entire operation to be very profitable.

Previously, studies had been made to determine practicality of using the stepping method for treating the long sections of green red pine trees. Samples of wood from trees so treated were taken and a chemical analysis was made by the Connecticut Agricultural Experiment Station. These analyses show the distribution of salts obtainable by the method, and

are the final data needed to evaluate the efficacy of treatment. Another type of treatment tried was the barrel method. Previous treatments had been given to a variety of species of posts cut in late fall and early spring. This year posts cut from trees in full leaf were treated. In addition, a similar set of posts was treated by capping the posts with rubber tubes containing dry salt. Once diffusion is completed, samples of the treated wood will be taken and the results analyzed to determine distribution of preservative. The remainder of the posts will be left in the ground for a service test.

A side-light of the sap-stream method of treatment was the discovery that careless handling of zinc chloride can be dangerous to trees. In an otherwise healthy plantation, a number of trees were found to be dying. Analysis of the wood showed that they had picked-up enough zinc chloride to kill them. Apparently, in treating other trees, some of the solution was spilled on the ground and enough was picked up by the roots of these trees to kill them.

Another study related to wood preservation was carried out. Red pine posts being pressure-treated at a Connecticut plant were measured for heartwood-sapwood ratio. Since heartwood of this species is resistant to preservative treatment it was felt that some saving of preservative might be possible if treatment was based on sapwood only. In the posts studied, the maximum amount of heartwood found in any diameter class was only 16 percent, which would not affect treating cost significantly.

WOOD CHEMISTRY

Charcoal offers important opportunity for utilizing poor-quality wood. At present, charcoal prices are excellent and demand is high. A study of Connecticut markets showed an annual consumption of approximately 20,000 tons, but a local manufacture of only 2,000 tons. In spite of this apparent opportunity, and also the availability of the efficient Connecticut cinder-block kiln, local interest in increasing production is lagging. Apparently what is needed is better information on kiln operation, and better analysis of available markets. For example, certain markets desire charcoal ground to specified fineness; others have a preference for a particular species of wood; still others demand briquettes; and others prefer lump charcoal. The situation in Connecticut

is probably not much different from that in much of the Northeast. Thorough studies of this field are urgently needed.

GENERAL

By correspondence, personal visits, or by referring to the Forest Products Laboratory a large number of inquiries from timberland owners and operators, questions on a great variety of subjects were answered. A member of our Forest Utilization Service served on the Forest Service Regional Equipment Committee and is an active member of the Northeastern Wood Utilization Council. Forest Utilization Service personnel participated in a major way in the activities of the Forest Products Research Society by presenting papers, acting upon Regional Advisory Board, and serving on the committee in charge of the 1951 National Meeting and Logging-Equipment Show to be held in Philadelphia May 7-13, 1951. Toward the end of the year, as the problems of defense grew, the Forest Utilization Service cooperated with the Forest Products Laboratory in studies of wood use in military establishments, and started organizing a Station project dealing with requirements, production, and supplies of timber.

PLANS FOR 1951

Timber Conversion

1. Serve as chairman on the Forest Products Research Society Logging-Equipment Show to be held in Philadelphia on May 7-13, 1951, in connection with the national annual meeting.

2. Study new developments in equipment as they appear.

3. Hold log-grading schools for state and national forest personnel.

4. Participate in the New York State College of Forestry study of low-grade hardwoods.

5. If Forest Products Laboratory help is available, make studies leading to the development of trade specifications for hardwood sawbolts.

6. Prepare three papers and review others in the series of 23 papers being prepared by Northeastern Technical Committee on Beech Utilization.

7. Study research projects carried on by various agencies dealing with wood-chip utilization.

Seasoning

1. Investigate new developments such as the Electro-kiln and Dryalator.

2. Cooperate with the Connecticut Agricultural Experiment Station in study of seasoning of oak fence posts.

3. Participate in such studies as are indicated by the Forest Products Laboratory national survey of package handling of lumber.

4. Study use of crop driers for drying lumber.

5. Participate in activities of the Keystone and Northeastern Dry Kiln Clubs.

6. Continue use of experimental kiln by the University of Maine in study of chemical brown stain control of eastern white pine.

Preservation

1. Make problem analysis of wood-preservation situation in the Northeast.

2. Complete cooperative work on diffusion preservative methods in cooperation with the State of Connecticut.

3. Make studies of the veneer industry in the Northeast.

Wood Chemistry

1. Study the operation of the Mellman charcoal unit.

General

1. Participate in activities of the Forest Products Research Society.

2. Continue as active member of the Northeastern Wood Utilization Council.

3. Advise the Forest Products Laboratory on its research program.

4. Continue to provide service to industry on technical problems.

1950

PUBLICATIONS

by members of the staff of the

NORTHEASTERN FOREST EXPERIMENT STATION

Barraclough, Solon, and Rettie, James C.
1950. THE OWNERSHIP OF SMALL FOREST-LAND HOLDINGS IN 23 NEW ENGLAND TOWNS. Northeast. Forest Expt. Sta. Paper 34. 32 pp., illus. Upper Darby.

The small owner (less than 5,000 acres) holds more than half of New England's forest land; so this survey was made to find out something about these owners, and thus to seek an approach to solving New England's forest problems. The authors found the fact that the owners of more than three-fourths of the forest acreage studied have occupational interests that do not require the use of their land for timber production goes a long way toward explaining the lack of concern about the management of small woodlands. About 62 percent of the forest land is held by people who realize that their land has timber values; the other owners do not include timber values at all in their reasons for holding the land.

Bruce, David, and Bickford, C. Allen.
1950. USE OF FIRE IN NATURAL REGENERATION OF LONGLEAF PINE. Jour. Forestry 48: 114-117, illus.

The authors discuss the use of fire in regenerating longleaf pine in Louisiana, and conclude that both stocking and early height growth can be improved by prescribed burning.

Curry, John R.
1950. MANAGEMENT OF SOUTHERN FORESTS. A. PRINCIPLES OF MANAGEMENT. Forest Farmer 9 (5): 11-15, illus.

A handbook-type article describing the details of forest management and silviculture for the small forest owner. Most of the material is aimed at management of southern forests, but is generally applicable to other regions as well.

Doverspike, George E.
1950. THE PROBLEM OF MARKETING TIMBER.
Forest Leaves 15 (1): 4, 12.

The marketing of primary forest products is years behind the times. Recognizing this, Congress authorized research on this problem in its Research and Marketing Act of 1946. The author describes a study of the problem on the Del-Mar-Va Peninsula and concludes that efficient marketing services and price-reporting services are badly needed. The woodland owner has little to guide him in selling timber and getting a fair price for it.

Dunwoody, Calvin B., and Doverspike, George E.
1950. RHODE ISLAND MARKETS FOR WOODLAND PRODUCTS.
R.I. State Col. Ext. Bul. 127. 10 pp.

A directory of forest-products markets in Rhode Island, with advice to the small owner on marketing timber, determining volume, and obtaining fair prices.

Fenton, R. H.
1950. A POSSIBILITY FOR PRODUCING MORE CHARCOAL.
Conn. Woodlands 15: 42.

Stand-improvement cuttings are needed in many of Connecticut's woodlands, but the problem is to find a market for the low-grade wood cut. One possible market is charcoal, for the people of Connecticut produce only 10 percent of the charcoal they use. Marketing thinnings for charcoal would make possible the profitable thinning of at least 4,000 acres of forest land per year.

1950. A PILOT STUDY OF THE USE OF LIGHT PORTABLE WOOD CHIPPERS. Northeast. Wood Util. Council Bul. 33: 41-47.

A preliminary report. See below.

1950. A PILOT STUDY OF THE USE OF LIGHT PORTABLE WOOD CHIPPERS. Pulp and Paper Mag. Canad. 51 (7): 132-133, 136.

A preliminary report. See below.

Fenton, R. H., and McKusick, H. A.
1950. A PILOT STUDY OF A PORTABLE WOOD CHIPPER. Northeast. Forest Expt. Sta. Paper 37. 18 pp., illus. Upper Darby.

A portable wood chipper was tested in Connecticut in an attempt to convert thinnings into salable products. The possible uses for chips include cattle and poultry litter, mulch, soil amender, and fuel. The chipper produced more than 1½ tons of chips per hour from brush and thinnings up to 4-inch diameter.

Filip, S. M.
1950. THINNING YOUNG OAK STANDS FOR SMALL MINE TIMBERS--AT A PROFIT. Forest Leaves 15 (1): 13.

Report on a profitable experimental thinning in a 30-year-old oak stand in Pennsylvania's Anthracite Region. A 40-percent cut paid wages; a 65-percent cut paid wages plus a fair profit. A 50-percent cut would probably be acceptable as a stand-improvement operation. Such thinnings might remove the incentive to clear-cutting and could build up stands to produce higher-quality timber.

Hale, Charles E., and Trimble, G. R., Jr.
1950. PERMANENT WILTING PERCENTAGES OF GLACIAL SOILS IN THE NORTHEAST. Jour. Soil and Water Conserv. 5 (3): 135-136.

Report of moisture content of soils at permanent wilting percentages, determined from samples collected during a flood-control survey in the Upper Susquehanna River watershed in New York State.

Harper, V. L.
1950. THE ACTIVITIES OF THE NORTHEASTERN FOREST EXPERIMENT STATION. Vt. Wood Prod. Conf. Rpt. 9 (1949): 6-13.

An outline of the work of the Northeastern Forest Experiment Station, including (1) timber- and watershed-management research, (2) forest surveys and flood-control surveys, and (3) forest utilization studies. Some details of the timber-management studies, watershed studies, economic studies, and the surveys. The author emphasizes that much of the work is carried on in cooperation with other agencies or individuals.

Hough, A. F.
1950. WEED KILLERS MAY BE USEFUL IN REFORESTING OLD BURNS. Northeast. Forest Expt. Sta., Northeast. Research Note 1. 4 pp. Upper Darby.

Of four chemical herbicides tested, ammate (ammonium sulfamate) proved effective in preparing planting sites in the Allegheny National Forest on slopes covered with bracken fern, goldenrod, and bush honeysuckle. Seedlings planted in the treated spots showed no sign of damage from the chemical.

Little, Silas Jr.
1950. ECOLOGY AND SILVICULTURE OF WHITECEDAR AND ASSOCIATED HARDWOODS IN SOUTHERN NEW JERSEY. Yale Univ. School Forestry Bul. 56. 103 pp., illus. New Haven.

Whitecedar (Chamaecyparis thyoides) has been called the most important timber tree in New Jersey. Stands have been heavily cut since Colonial days. The author suggests that whitecedar be grown in pure, even-aged stands. Proper harvest cuttings, thinnings, and other treatments should permit perpetuation of such stands with little difficulty and expense. Fire, fungi, insects, and climate offer no serious problems.

---------- and Moore, E. B.
1950. EFFECT OF PRESCRIBED BURNS AND SHELTERWOOD CUTTING ON REPRODUCTION OF SHORTLEAF AND PITCH PINE. Northeast. Forest Expt. Sta. Paper 35. 11 pp. Upper Darby.

Results of prescribed-burning studies in southern New Jersey confirm earlier reports that prescribed fires favor the establishment of pine reproduction. The amount of pine reproduction increases with the number of burns used. A shelterwood cutting before burning also encouraged establishment of pine seedlings.

Lockard, C. R.
1950. HARDWOOD LOG GRADING--A PHASE OF QUALITY CONTROL. Forest Prod. Res. Sec. Preprint. 9 pp.

The author points out that the variability of trees and the diversity of use requirements indicate the need for a realistic system of log grading. The essential requirements of such grades are outlined, as well as some of the difficulties involved in their formulation. A system of hardwood log grades is discussed in some detail.

Lockard, C. R.
1950. THE PROBLEM OF HARDWOOD LOG GRADING.
Forest Prod. Res. Soc. Proc., Northeast. Sect.. Sect. 8: 1-6. Syracuse, N. Y.

A discussion of the need for workable log-grading methods. The timber grower needs some such method for appraising his timber crop; the timber user needs it to determine log value and lumber quality. The basic requirements of a log-grading system are outlined.

---------- and Hurbesky, C. E.
1950. THE SATURATING FELT INDUSTRY IN THE NORTHEAST AS A MARKET FOR WOOD CHIPS. Northeast. Wood Util. Council Bul. 33: 107-116.

Reviewing the raw material requirements of the saturating felt industry (composition roofing, floor coverings, etc.), the authors find that the felting industry in the Northeast uses about 200,000 cords of rough round wood annually--one third hardwood, two thirds softwood. The use of this amount of wood was made possible by recent development of equipment that can defibrate wood cheaply, to make fiber that has excellent felting properties and can replace expensive and unstable-priced rag fiber.

---------- Putnam, J. A., and Carpenter, R. D.
1950. LOG DEFECTS IN SOUTHERN HARDWOODS.
U.S. Dept. Agr., Agr. Handb. 4. 37 pp., illus.

This publication describes what are probably the least well understood of the factors that determine log quality--the indicators of defect that appear on the surfaces or ends of logs. These defects (bumps, canker, knots, wounds, rot, shake, worm holes, and so forth) are useful in appraising hardwood timber and grading hardwood logs.

McLintock, T. F.
1950. WHY FOREST MANAGEMENT?
Paper Indus. 1950: 1314-1316.

A general discussion of the need for forest management in Maine. Citing the great loss of timber through natural causes and neglect, the author outlines some of the advantages of forest management and describes briefly the research efforts being made to develop further a realistic and economical program for conserving Maine's forest resource.

McLintock, T. F.

1950. MANAGEMENT IN MAINE.
Maine Forester 1950: 43-50. Univ. Maine.

As a wood-manufacturing plant, the average forest in Maine is grossly inefficient. Reviewing the present status of forest management in Maine, the author points out an opportunity for improvement. "The opportunity for intensified management is equalled by the potential market: both are practically unlimited."

McQuilkin, William E.

1950. PRESERVATIVE TREATMENTS FOR CLOTH NURSERY-BED COVERS. Jour. Forestry 48: 351-353, illus.

Report on 10 treatments tested to preserve cloth used for nursery-bed covers. Results, based on three or four seasons of service, were not conclusive. Copper naphthenate-asphalt-bentonite approached consistently good performance more closely than any other. Two organic dyes, fustic and quercitron, performed essentially as well as the napthenates. Both the dyes and naphthenates showed promise and merit further testing.

1950. EFFECTS OF SOME GROWTH REGULATORS AND DRESSINGS ON THE HEALING OF TREE WOUNDS. Jour. Forestry 48: 423-428.

A series of 11 studies, involving 646 trees and 13,560 wounds, was started in 1942 in cooperation with the Camouflage Branch of the Army Engineer Board. Summarizing the results, the author concludes that lanolin has proved to be consistently effective as a wound-dressing material. Shellac and growth regulators did not promote healing of wounds.

1950. PREPARING PLANTING SITES WITH SILVICIDES.
Forest Leaves ~~15~~ 35 (1): 13, 20.

Pennsylvania has more than 2 million acres in scrub oak and other poor species. Most of this land would grow good timber if planted, but planting costs are prohibitive. Chemical plant killers such as Ammate and 2,4-D are being tried experimentally to eradicate brushy vegetation and prepare planting sites. No definite results reported yet.

Northeastern Forest Experiment Station.
1950. BIBLIOGRAPHY OF THE NORTHEASTERN AND ALLEGHENY FOREST EXPERIMENT STATIONS, 1923-1949. Northeast. Forest Expt. Sta. Paper 33. 208 pp. Upper Darby.

An annotated bibliography of Forest Service (and cooperative) research in the Northeast, containing more than 800 items, classified by subject matter. Author index.

1950. ANNUAL REPORT, 1949.
Northeast. Forest Expt. Sta. 66 pp., illus.

Rettie, James C., and Ineson, Frank A.
1950. OTSEGO FOREST PRODUCTS COOPERATIVE ASSOCIATION OF COOPERSTOWN, NEW YORK: AN EVALUATION. U. S. Dept. Agr., Agr. Inf. Bul. 17. 42 pp., illus.

The Otsego Cooperative was organized in 1935 to assist woodland owners in marketing their timber products and at the same time improve their woodlands. This is an account of the cooperative and how it met its problems and became a successful enterprise. The authors describe the forestry program of the cooperative and how it serves its members, and they conclude by offering advice to anyone who is interested in organizing and operating a woodland owners' cooperative.

Rutherford, William, Jr.
1950. REPRODUCTION OF ADIRONDACK HARDWOODS.
N.Y. State Ranger School Alumni News 1949: 12-14.

In the Adirondacks, defective beech that comes in after logging, and makes up as much as 80 percent of hardwood stands, is a major barrier to good forest management because much of it is defective and there are few markets for it. The author described silvicultural attempts to favor reproduction of the more valuable hard maple and yellow birch.

Sartz, Richard S., and Huttinger, William D.
1950. SOME FACTORS AFFECTING HUMUS DEVELOPMENT IN THE NORTHEAST. Jour. Forestry 48: 341-344, illus.

Humus development was studied during a flood-control survey of the Allegheny River watershed. The authors found that humus depth increases with age of stand until maximum foliage production is reached; and that density of stand controls the balance between organic accumulation and decom-

position. Logging, fires, and grazing tend to destroy humus layers. Northeast slopes seem to develop deeper humus, and microtopographic features cause extreme variations in humus depth. Heavy-texture soils apparently develop more humus than sandy soils.

Schreiner, Ernst J.
1950. GENETICS IN RELATION TO FORESTRY.
Jour. Forestry 48: 33-38, illus.

The author reviews the progress of forest genetics in both Europe and this country. He advocates increased use of improved trees but emphasizes that planting of hybrids is not the ultimate goal. Improvement cuttings based on inherent superiority of individuals may produce the desired results. More research is needed, and forestry schools should give more training in genetics.

1950. CLONAL SELECTION CAN PROVIDE BETTER SHADE TREES.
Natl. Shade Tree Conf. Proc. 25: 53-56.

Suggests cooperative action by city shade-tree people in finding and testing the best trees for city planting. In selection--no job for amateurs--the physiological characteristics of the tree are most important. The costs of testing selected clones could be reduced by using specimens of the clones in regular street or park planting programs.

1950. CAN BLACK WALNUT POISON PINES.
The Shade Tree 23 (1): 2.

Juglone, a chemical substance given off by the roots of black walnut trees, is reported to kill or stunt a number of plants. The author reports that black walnut trees along the border of a pine plantation (Scotch, Norway, Austrian, Japanese red, Japanese black, and hybrid pines) near State College, Pa., have killed pines. Be careful, he says, where you plant black walnut trees.

Simmons, Fred C.
1950. HELPING THE LOGGER.
Forest Leaves 15 (1): 9-10.

Pennsylvania loggers have been quick to adopt new equipment that makes logging jobs easier, safer, and more

productive. The author describes some of the new developments in logging and the part the Forest Utilization Service plays in encouraging new methods and equipment. Examples are cited of Pennsylvania loggers who have developed new and profitable methods.

Simmons, Fred C.
1950. WHAT'S NEW IN SAWMILLING?
Vt. Wood Prod. Conf. Rpt. 9 (1949): 27-34, illus.

Since the end of World War II, new developments in logging methods and equipment have come thick and fast. The author discusses new developments in log preparation, log carriages, saws and husks, resaws, edgers, conveyors, trim saws, yard handling, new types of mills such as portable sawmills.

1950. NEW DEVELOPMENTS IN HARVESTING SAWLOGS.
Forest Prod. Res. Soc. Proc. 3 (1949): 33-43, illus.

Since World War II changes in logging equipment and methods have been rapid and spectacular. New types of saws, tractors, and other items have appeared, spurred by the scarcity of old-time woodsmen and the aversion of young men to old-fashioned methods. The author describes some of these new developments and discusses some of the problems experienced in adopting them.

1950. NEW DEVELOPMENTS IN HARVESTING SAWLOGS.
Timber of Canada 10 (9): 25-28, 50, 52, 56-60, illus.

See above.

Somes, H. A., and Moorhead, G. R.
1950. PRESCRIBED BURNING DOES NOT REDUCE YIELD FROM OAK-PINE STANDS OF SOUTHERN NEW JERSEY. Northeast. Forest Expt. Sta. Paper 36. 19 pp. Upper Darby.

Data on mortality, basal wounding, and growth, gathered during prescribed burning studies begun in 1936 and 1940, indicate that the prescribed treatment with light winter fires does some damage, but it is slight and does not nullify the

value of prescribed burning as a silvicultural tool for getting pine seedlings established.

Westveld, Marinus, MacAloney, H. J., and Hansbrough, J. R.
1950. FOREST CROP SECURITY: THE RIGHT TREE ON THE RIGHT SITE. Forestry Chron. 26: 144-151.

Silviculturists believe that attainment of productive, healthy forests can be greatly facilitated by striving for stand compositions that are natural to the sites. The climax forest can be used as the guide to these compositions. In striving for such forests, the silviculturist must use cutting practices that will avoid soil deterioration, fire, and erosion, and will maintain as nearly as possible the composition of the plant community.

Whelan, Donald E.
1950. A METHOD OF EVALUATING THE HYDROLOGIC EFFECTS OF LAND USE ON LARGE WATERSHEDS. Trans. Amer. Geophys. Union 31 (2): 253-261, illus.

Presents a new method of analysis for determining effect of land use on runoff. The total flood hydrograph is subdivided into separate hydrographs for surface, subsurface, and groundwater runoff. A unit hydrograph is derived by considering surface and subsurface runoff contributing simultaneously by unit time periods. The total flood hydrograph as it would be modified by a corrective land-use program is computed by using the derived unit hydrograph, groundwater relations, and changes in land use.

MANUSCRIPTS SUBMITTED

BUT NOT PUBLISHED DURING 1950

Bethlahmy, Nedavia.
AN ALINEMENT CHART FOR USE WITH THE FIBERGLAS SOIL-MOISTURE INSTRUMENT. Soil Sci.

Curry, John R.
ADIRONDACK FORESTRY PROBLEMS, 1900-1950.
Soc. Amer. Foresters Proc.

PRINCIPLES OF FOREST MANAGEMENT.
Forest Farmer.

Harper, V. L.
A CLASSIFICATION OF FOREST-MANAGEMENT PRACTICES.
Submitted to Soc. Amer. Foresters committee for inclusion in book on "Methods and scope of forest economics research."

ADVANCED DEGREES AND PUBLIC AGENCY EMPLOYEES.
Submitted to Soc. Amer. Foresters committee.

Hough, A. F.
TREE ROOTS.
Pa. Forests.

Little, S.
OBSERVATIONS ON THE MINOR VEGETATION OF THE PINE BARREN SWAMPS IN SOUTHERN NEW JERSEY. Torrey Bot. Club Bul.

McGuire, John R.
WHITE PINE RESEARCH IN MAINE.
Maine Forester.

Schreiner, Ernst J.
OF FOREST TREES AND HONEYBEES.
Pa. Forests.

Simmons, Fred C.
NORTHEASTERN LOGGERS' HANDBOOK.
U. S. Dept. Agr., Agr. Handbook 6. 160 pp., illus.

Westveld, Marinus.
VEGETATION MAPPING AS A GUIDE TO BETTER SILVICULTURE.
Ecology.

Wray, Robert D.
ANY FORESTER CAN USE AERIAL PHOTOGRAPHS.
Jour. Forestry.

MANUSCRIPTS TO BE SUBMITTED IN 1951

FOR PUBLICATION BY U.S.D.A.

McGuire, John R., Rettie, James C., and Gilbert, Adrian M.
THE FOREST RESOURCES OF VERMONT.
U. S. Dept. Agr.

Rettie, James C., McGuire, John R., and Gilbert, Adrian M.
THE FOREST RESOURCES OF NEW HAMPSHIRE.
U. S. Dept. Agr.

OTHER PUBLICATIONS PLANNED

(* indicates manuscript has been prepared and is being reviewed, revised, edited, or prepared for printing.)

Barraclough, Solon.
CASE HISTORIES IN THE ECONOMICS OF FOREST MANAGEMENT.

Bethlahmy, Nedavia.
A METHOD FOR DETERMINING THE WATER CONTENT OF SOILS.

WHY DO PLANTS WILT IN COLD WEATHER?

Bickford, C. Allen
* FORM-CLASS VOLUME TABLES FOR ESTIMATING BOARD-FOOT CONTENT OF NORTHERN CONIFERS. Northeast. Forest Expt. Sta. Paper.

---

* INVENTORY SAMPLING DESIGN FOR FOREST SURVEY IN THE NORTHEAST.

Church, Thomas W., Jr.
WINTER INJURY TO CONIFERS IN THE ADIRONDACKS.

Clark, T. C., and Weitzman, S.
EARLY GROWTH OF PLANTATIONS IN THE SPRUCE-FIR TYPE IN WEST VIRGINIA.

Curry, J. R., and Rushmore, F. M.
MECHANICAL POISONING OF ADIRONDACK HARDWOOD HOLDOVERS SAVES MANPOWER.

Dill, H. W., Jr.
* A METHOD FOR USING AERIAL PHOTOS IN LAND-USE INVENTORY.

Doverspike, George E., Rettie, James C., and Camp, Harry W., Jr.
* TIMBER MARKETS AND MARKETING IN THE MONOCACY RIVER WATERSHED OF MARYLAND AND PENNSYLVANIA. Northeast. Forest Expt. Sta. Paper.

——— and Camp, Harry W., Jr.
* HARDWOOD LOG GRADES—A GUIDE TO VALUE. Results of four test demonstrations in the Northeast. Northeast. Forest Expt. Sta. Paper.

Fenton, R. H.
* UNUSUAL CAUSE OF DEATH IN RED PINE PLANTATIONS. Northeast. Forest Expt. Sta. Research Note.

———
* A PROFITABLE NEW USE FOR TREATED PLANTATION-GROWN PINE. Northeast. Forest Expt. Sta. Research Note.

Hart, A. C., and Jensen, V. S.
COST AND MANPOWER REQUIREMENTS OF PRODUCING PULPWOOD IN PARTIAL CUTTINGS OF SPRUCE-FIR FORESTS.

Holcomb, C. J., and Bickford, C. A.
* GROWTH OF COVE HARDWOODS AND YELLOW-POPLAR IN WEST VIRGINIA.

Hough, A. F.
* PRELIMINARY RESULTS OF RED PINE SEED SOURCE TESTS ON THE KANE EXPERIMENTAL FOREST.

———
CORDWOOD THINNINGS IN ALLEGHENY HARDWOODS TO INCREASE FOREST PRODUCTION.

Hough, A. F.
PULPWOOD CUTTINGS TO SECURE BIACK CHERRY REGENERATION IN SECOND-GROWTH ALLEGHENY PLATEAU FORESTS—A TEN-YEAR EXPERIENCE.

Jensen, V. S.
REPRODUCTION AND METHODS OF HARVEST CUTTING IN NORTHERN HARDWOODS.

———— and Wilson, Robert W., Jr.
* GIRDLING AND MOWING ADVANCE REPRODUCTION IN NORTHERN HARDWOOD STANDS.

Leflof, E. A.
* BEECH FOR FLOORING.
Northeast. Beech Util. Series.

Little, S.
* MECHANICAL PREPARATION OF SEEDBEDS IN CONVERTING OAK-PINE STANDS TO PINE.

———— and Somes, H. A.
SIX-YEAR RESULTS FROM FIELD TESTS OF HYBRIDS OF PITCH, LOBLOLLY, AND SHORTLEAF PINES.

———— and Somes, H. A.
TESTS OF DEER REPELLANTS ON SHORTLEAF AND PITCH PINE REPRODUCTION IN SOUTHERN NEW JERSEY.

———— and Somes, H. A.
SILVICIDES SAVE LABOR IN SOUTHERN NEW JERSEY HARDWOOD CONTROL.

———— and Somes, H. A.
* DEER BROWSING IN NEW JERSEY HANDICAPS PINE SEEDLINGS.
Northeast. Forest Expt. Sta. Research Note.

———— Somes, H. A., and Allen, J. P.
* CHOOSING SUITABLE TIMES FOR PRESCRIBED BURNING IN SOUTHERN NEW JERSEY.

Lockard, Charles R.
* BEECH FOR TURNING.
Northeast. Beech Util. Series.

McGuire, John R., and Gilbert, Adrian M.
FOREST STATISTICS FOR VERMONT.
Northeast. Forest Expt. Sta. Forest Survey Release.

McGuire, John R., and Gilbert, Adrian M.
FOREST STATISTICS FOR WEST VIRGINIA.
Northeast. Forest Expt. Sta. Forest Survey Release.

McQuilkin, W. E.
* WEED KILLERS OF LIMITED USE IN REFORESTING SCRUB BARRENS.

———
COST OF PLANTING IN BULLDOZED FURROWS IN THE SCRUB OAK TYPE.

Northeastern Forest Experiment Station.
* SURVEY REPORT ON MERRIMACK RIVER WATERSHED, NEW HAMPSHIRE AND MASSACHUSETTS.

Ostrander, Myron K.
PILING AND POLES—A PROFITABLE MARKET FOR FARM FOREST TIMBER.

Paul, B. H., and Drow, J. T.
* PHYSICAL AND MECHANICAL PROPERTIES OF BEECH.
Northeast. Beech Util. Series,

Potter, H. S., Weitzman, S., and Trimble, G. R., Jr.
* REFORESTATION OF STRIP-MINED LANDS IN WEST VIRGINIA.

Rettie, James C., Doverspike, George E., and Banks, Wayne G.
* FOREST RESOURCES OF THE MONOCACY RIVER WATERSHED IN MARYLAND AND PENNSYLVANIA. Northeast. Forest Expt. Sta. Paper.

——— and Wray, Robert D.
* FOREST STATISTICS FOR NEW HAMPSHIRE.
Northeast. Forest Expt. Sta. Forest Survey Release 9.

Scheffer, T. C., and Zabel, R. A.
* STORAGE OF BEECH LOGS AND BOLTS IN THE NORTHEAST.
Northeast. Beech Util. Series.

Schreiner, E. J.
SUMMARIES OF TREE BREEDING AT THE NORTHEASTERN STATION, 1937-42, WITH DESCRIPTIONS OF PROGENIES.

Simmons, Fred C.
* LOGGING BEECH.
Northeast. Beech Util. Series.

Somes, H. A.
* COST OF PRESCRIBED BURNING CONTINUES TO GO DOWN. Northeast. Forest Expt. Sta. Research Note.

Storey, H. C.
* FOREST AND WATER RESEARCH ON THE DELAWARE-LEHIGH EXPERIMENTAL FOREST. Pa. Dept. Forests and Waters.

Trimble, G. R., Hale, C. E., and Potter, H. S.
* EFFECT OF SOIL AND COVER CONDITIONS ON SOIL-WATER RELATIONSHIPS. Northeast. Forest Expt. Sta. Paper.

Whelan, Donald E.
* DETERMINATION OF SURFACE RUNOFF BY ROUTING INFILTRATED WATER THROUGH THE SOIL. Amer. Geophys. Union Trans.

Wright, Jonathan W.
* TREE BREEDING TECHNIQUE: EFFECTS OF BAGGING ON FRUIT AND SEED SET. Northeast. Forest Expt. Sta. Research Note.

---

* POLLEN DISPERSION OF SOME FOREST TREES.

PRACTICAL ASPECTS OF POLLEN DISPERSION.

TREE BREEDING RESULTS: PINE, ASH, MAPLE, FIR, OAK, SPRUCE, YELLOW-POPLAR. (Series of reports.)

COLLECTION OF SEED FROM ISOLATED TREES. Morris Arboretum Bulletin.

THE RESEARCH CENTERS AND EXPERIMENTAL FORESTS AND WATERSHEDS of the NORTHEASTERN FOREST EXPERIMENT STATION

Under the authority of the McSweeney-McNary Act, the Forest Service conducts research in three broad fields: (1) forest, range, and watershed management, (2) forest-resource surveys, and (3) forest-products utilization. This research is being done at a National Forest Products Laboratory, at 11 regional experiment stations in the United States, at a station in Puerto Rico, and at a research center in southeast Alaska. The Northeastern Station is one of the 11 regional experiment stations.

Laboratory research on forest products is centered at the Forest Products Laboratory at Madison, Wis. Liaison with regional needs for research in wood utilization is aided by the Station's small Forest Utilization Service unit at Upper Darby.

Forest-resource surveys and related economic studies comprise a major activity at the Northeastern Station. This program requires the utmost mobility; so personnel are attached directly to the regional headquarters of the Station and work widely over the Northeast, with frequent changes of temporary headquarters in the field.

Regional research in forest and watershed management in the Northeast is conducted chiefly at a series of experimental forests and field laboratories. The major criterion in selecting an experimental forest, watershed, or other field laboratory is the extent to which it represents the problems of a regional type or problem area. In some cases more than one such experimental area is needed for adequate coverage of a regional type. Although the majority of research is concentrated on these experimental areas, some supplementary work in other conditions on outside lands is carried on.

To facilitate field operations, the work on one or more experimental areas and on nearby lands is usually directed through nearby offices known as research centers. These centers are convenient organizational devices that reduce travel costs and keep research personnel in intimate contact with their particular phases of a regional research project as well as with local cooperating agencies. Specialists located at the regional headquarters of the Station at Upper Darby participate in the research at the various centers and assist in the preparation of work plans and analyses of research results.

Following are the research centers and their locations, including the experimental forests and watersheds where the research is concentrated. The regional problem area or type is shown in parenthesis after the name of the research center. The location of the experimental forests and field laboratories are shown on the map.

Penobscot (spruce-fir primarily, with admixture of hardwoods):
64 Coe Building, 15 Cross Street, Bangor, Maine.
1. Penobscot
2. Gale River

White Pine (white pine primarily, admixture of low-quality and weed hardwoods): Alfred, Maine.
3. Massabesic

Northern Hardwoods (northern hardwoods primarily, admixture of other types; critical watershed areas): Forest Service Building, Laconia, N.H.
4. Bartlett
5. Lawrence Hopkins Memorial

Adirondacks (spruce-fir and northern hardwoods, intermingled in small area, pure stands): Paul Smiths, N. Y.
6. Paul Smith
7. Finch-Pruyn

Allegheny Plateau (Allegheny hardwoods; critical watersheds): Upper Darby, Pa.
8. Kane

Anthracite (oak, with admixture of miscellaneous hardwoods and softwoods): Post Office Building, Kingston, Pa.
9. Pocono
10. Standing Stone

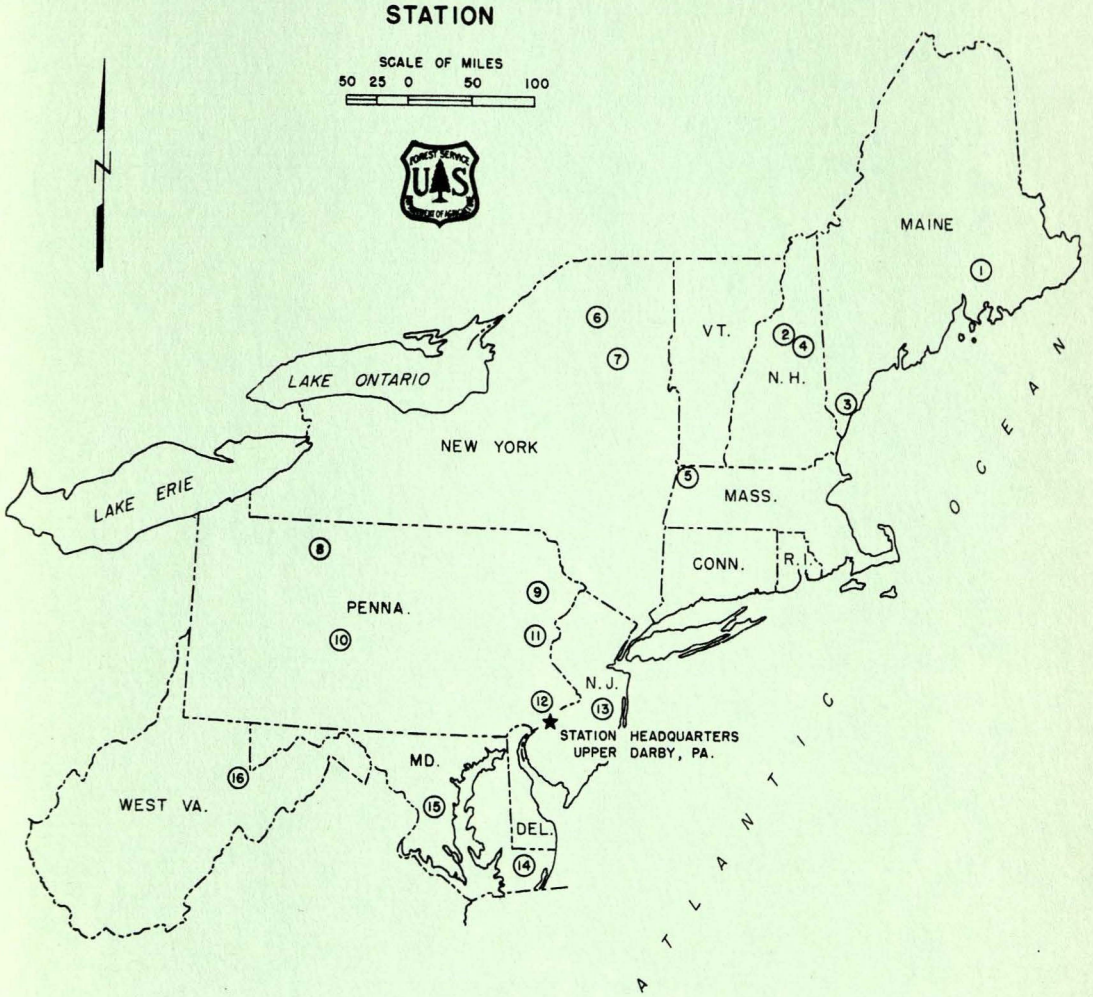
Delaware Basin (watershed of Delaware River): Williams Hall, Lehigh University, Bethlehem, Pa.
11. Delaware-Lehigh.

Morris Arboretum (forest genetics work, primarily on hardwoods and national in scope): Upper Darby, Pa.
12. Morris Arboretum

Coastal Oak-Pine (oak-yellow pine, Virginia pine, Atlantic cedar): Upper Darby, Pa.
13. Lebanon
14. Eastern Shore
15. Beltsville

Mountain State (Appalachian hardwoods, cove hardwoods, chestnut oak, steep and critical watershed areas): Forest Service Building, Elkins, West Virginia.
16. Fernow

REGION SERVED BY THE NORTHEASTERN FOREST EXPERIMENT STATION



EXPERIMENTAL FORESTS AND FIELD LABORATORIES

1	PENOBSCOT	9	POCONO
2	GALE RIVER	10	STANDING STONE
3	MASSABESIC	11	DELAWARE - LEHIGH
4	BARTLETT	12	MORRIS ARBORETUM
5	HOPKINS	13	LEBANON
6	PAUL SMITH	14	EASTERN SHORE
7	FINCH - PRUYN	15	BELTSVILLE
8	KANE	16	FERNOW

U. S. DEPARTMENT OF AGRICULTURE - FOREST SERVICE
NORTHEASTERN FOREST EXPERIMENT STATION